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ANNOTATED BIBLIOGRAPHY OF THE AIR FORCE
HUMAN RESOURCES LABORATORY
TECHNICAL REPORTS — 1978

By
Esther M. Barlow

TECHNICAL SERVICES DIVISION
Brooks Air Force Base, Texas 78235

June 1980

Final Report

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LABORATORY

AIR FORCE SYSTEMS COMMAND
BROOKS AIR FORCE BASE, TEXAS 78235

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This annotated bibliography presents a listing of technical reports (1978) dealing with personnel and training research conducted by the Air Force Human Resources Laboratory (AFHRL). The research has been conducted by professional personnel representing a variety of disciplines, including psychologists, operations research specialists, mathematicians, computer analysts, economists, electronic engineers, aeronautical engineers, and technical support personnel. AFHRL is charged with the planning and execution of Air Force exploratory and advanced development programs for selection, motivation, training, retention, education, assignment, utilization, and career development of military personnel; also the composition of the personnel force and training equipment. In addition, this Laboratory provides technical and management assistance to

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support studies, analyses, development planning activities, acquisition, text evaluation, modification, and operation of aerospace systems and related equipment.

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ANNOTATED BIBLIOGRAPHY OF THE AIR FORCE HUMAN RESOURCES LABORATORY TECHNICAL REPORTS — 1978

INTRODUCTION

The Air Force Human Resources Laboratory (AFHRL), Brooks AFB, Texas, was established in 1968 as an Air Force Systems Command (AFSC) laboratory. (During the early part of 1968, it was part of the Aerospace Medical Division.)

This Laboratory is charged with the planning and execution of Air Force exploratory and advanced development programs for selection, motivation, training, retention, education, assignment, utilization, and career development of military personnel; also the composition of the personnel force and training equipment. This Laboratory also provides technical and management assistance to support studies, analyses, development planning activities, acquisition, test evaluation, modification, and operation of aerospace systems and related equipment.

At the end of 1978, AFHRL consisted of a headquarters and three divisions at Brooks AFB and three geographically dispersed divisions as follows:

1. Computational Sciences Division, Occupation and Manpower Research Division, and Personnel Research Division, Brooks AFB, Texas.

2. Advanced Systems Division, Wright-Patterson AFB, Ohio.

3. Flying Training Division, Williams AFB, Arizona.

4. Technical Training Division, Lowry AFB, Colorado.

Abstract entries list the division name at the time of report publication.

The abstracts appear in technical report number sequence. Entries following the author and title heading give information identifying the report and indicate where it is available:

Project number: Research areas identified by these numbers are given in the PROJECT index. The Air Force contract number and the name of the contracting organization are entered for contract-produced reports.

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To obtain copies of reports without DTIC accessioned document (AD) numbers, furnish the names of authors, titles, report numbers, and dates to DTIC or NTIS.

This bibliography contains six indexes: PERSONAL AUTHOR, CIVILIAN CORPORATE AUTHOR, PROJECT, TITLE, DIVISION, and KEYWORD. Reports are identified in the indexes by the serial number appearing in the left margin of the abstract entries. This report does not contain classified or For Official Use Only technical reports.

1 Barlow, E.M. Annotated bibliography of the Air Force Human Resources Laboratory technical reports — 1976. AFHRL-TR-78-1, AD-A051 982. Brooks AFB, TX: Headquarters Air Force Human Resources Laboratory, January 1978. (Covers all AFHRL projects.) NTIS. This annotated bibliography presents a listing of technical reports (1976) dealing with personnel and training research conducted by the Air Force Human Resources Laboratory (AFHRL).

The research has been conducted by professional personnel representing a variety of disciplines, including psychologists, operations research specialists, mathematicians, computer analysts, economists, electronic engineers, aeronautical engineers, and technical support personnel.

AFHRL is charged with the planning and execution of USAF exploratory and advanced development programs for selection, motivation, training, retention, education, assignment, utilization, and career development of military personnel; also the composition of the personnel force and training equipment. This Laboratory also provides technical and management assistance to support studies, analyses, development planning activities, acquisition, test evaluation, modification, and operation of aerospace systems and related equipment. (56 pp.)

2 Czuchry, A.J., Glasier, J.M., Kistler, R.H., Bristol, M.A., Baran, H.A., & Dieterly, D.L. Digital Avionics Information System (DAIS): Reliability and maintainability model. AFHRL-TR-78-2(I), AD-A056 530. Wright-Patterson AFB, OH: Advanced Systems Division, April 1978. Project 2051, Contract F33615-75-C-5218, Dynamics Research Corporation. NTIS. The reliability and maintainability (R & M) model described in this report represents an important portion of a larger effort called the Digital Avionics Information System (DAIS) Life Cycle Cost (LCC) Study. The R & M model is the first of three models that comprise a modeling system for use in LCC analysis of avionics systems. The total system will provide the Air Force with an enhanced in-house capability to incorporate LCC considerations early in the system acquisition process. As part of the overall modeling system, the R & M model provides estimates of failure rates, maintenance manpower requirements, support equipment requirements, and spares requirements which are used to generate estimates of system support costs. When operated in a stand-alone mode, the R & M model can be utilized to analyze the impact of various avionics design configurations on system support requirements.

This report describes the R & M model in detail. The technical approach is discussed in general and then specific terms. Particular attention is given to the analysis that led to the model specification and to the model's functional description in terms of input, output, and process. A specific example calculation is given to illustrate how the model can be utilized to conduct an R & M study. (60 pp.)

3 Czuchry, A.J., Kistler, R.H., Glasier, J.M., Bristol, M.A., Baran, H.A., & Dieterly, D.L. Digital Avionics Information System (DAIS): Reliability and maintainability model users guide. AFHRL-TR-78-2(II), AD-A068 826. Wright-Patterson AFB, OH: Advanced Systems Division, April 1979. Project 2051, Contract F33615-75-C-5218, Dynamics Research Corporation. NTIS. The digital avionics information system (DAIS) life cycle cost (LCC) study provides the Air Force with an enhanced in-house capability to incorporate LCC considerations during all stages of the system acquisition process. This report documents a reliability and maintainability (R & M) model developed in the study and also serves as a users manual. The R & M model, a training model, and a cost model comprise the DAIS LCC impact model (LCCIM) designed for use in LCC analysis of avionics systems. In this context, its primary function is to manipulate

input data banks to produce intermediate products, figures of merit, and outputs required by the training and cost models. When used in a stand-alone mode, the R & M model provides a means for analyzing the R & M impact of changes in system design and maintenance concepts on system support requirements.

The input data banks contain values for the R & M parameters of avionics hardware configurations, i.e., maintenance action rate, maintenance task event time, task event probability of occurrence, manpower required for each task, skill level requirements, and support equipment (SE) required for each task. The R & M model employs a figure of merit concept to aggregate the values for these R & M parameters to produce manhour and SE requirement estimates. These are point estimates; however, they can be used to (a) make comparisons on a total system, subsystem, or line replaceable unit (LRU) basis, and (b) identify "high drivers" or problem areas in terms of resource requirements. In addition, the R & M model can be used to conduct sensitivity and trade-off analyses in terms of resource requirements after it has identified high driver items. It can perturb combinations of R & M parameters to determine sensitivities. Thus, alternatives for achieving a reduction in resource requirements can be assessed by selectively altering input data and observing the model's outputs indicating the resultant changes in resource requirements.

This document is intended to guide the user of the R & M model. It describes the features of the model, its logical operations, its input data requirements, and its output reports. It also provides a program listing, instructions for preparing input data, and guidance for interpreting and using output reports. (138 pp.)

4 Kantor, J.E., Klinestiver, L., & McFarlane, T.A. Methodology to assess psychological stress and its impact in the air combat environment. AFHRL-TR-78-3, AD-A053 474. Brooks AFB, TX: Personnel Research Division, March 1978. Project USAD. NTIS. Operations within an air combat environment are typically associated with subjective feelings of strain, pressure, and tension. These feelings are referred to as stress and can impact on performance within the combat setting. To identify which pilot operations commonly produce stress, to assess the level of stress generated by those operations, and to evaluate the impact of stress on combat performance, a Combat Stress Questionnaire was developed for administration to combat experienced fighter pilots. A trial administration was conducted using members of the San Antonio Chapter of the Red River Fighter Pilots' Association, and these preliminary findings are presented. Written comments were solicited from these respondents and combined with the preliminary findings; there appear to be indications that while combat per se generates the most severe stress, it is stress experienced prior to combat which is associated with performance. Plans for extended data collection and the usefulness of these data to scientific inquiry, training, and the operational environment are discussed. A copy of the Combat Stress Questionnaire is provided in the appendix. (16 pp.)

5 Albery, W.B., & McGuire, D.C. Emulation of an advanced G-seat on the Advanced Simulator for Pilot Training. AFHRL-TR-78-4, AD-A055 532. Wright-Patterson AFB, OH: Advanced Systems Division, April 1978. Project 6114. NTIS. An in-house effort was initiated to investigate simple G-seat hardware configurations for the purpose of developing a low-cost approach to G-cuing simulation in flight trainers. The G-seat is a motion and force simulation device which replaces the aircraft seat in a flying training simulator; by virtue of its geometry and software drive, it imparts tactile cues to the seated pilot which are representative of the seat forces normally experienced in actual flight. The Air Force and Navy are procuring G-seats for both training and fighter simulators. These G-seats are research devices, and have up to 32

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actuators distributed in the seat pan, backrest, and lap belt. These seats can be improved upon with respect to simpler geometry. fewer active components. and more effective drive algorithms. This report describes a research effort on the Air Force's Advanced Simulator for Pilot Training (ASPT) which culminated in the emulation of an advanced approach to G-seat simulation. The development of the software, the design of the advanced seat components. the implementation of the advanced design on the ASPT, and the results of the study are presented. (36 pp.)

6 Colle, H.A., & De Maio, J. Measurement of attentional capacity load using dual-task performance operating curves. AFHRL-TR-78-5, AD-A055 690. Williams AFB, AZ: Flying Training Division. April 1978. Project 2313. NTIS. A fixed attentional capacity theory of human attentional limitations was tested to determine its ability to predict the combination of tasks pilots could perform together without noticeable decrements. Three cognitive tasks and a simulated formation flying task were performed singly and in pairs.

Performance operating curves generated by dual-task performance on pairs of the cognitive tasks were estimated successfully. Their equivalent attentional demands were found. The flying task had a very small. but measurable attentional demand. as determined from dual-task performance. Performance on the cognitive tasks that were performed together with the flying task was consistent with the capacity theory. However. the small attentional demand needed to perform the flying task prevented a strong test of the theory. (16 pp.)

7 Goclowski, J.C., King, G.F., Ronco, P.G., & Askren, W.B. Integration and application of human resource technologies in weapon system design: Coordination of five human resource technologies. AFHRL-TR-78-6(I), AD-A053 680. Wright-Patterson AFB, OH: Advanced Systems Division. March 1978. Project 1959. Contract F33615-77-C-0016. Dynamics Research Corporation. NTIS. The five human resource technologies are defined as maintenance manpower modeling (MMM). instructional system development (ISD). job guide development (JGD). system ownership costing (SOC), and human resources in design trade-offs (HRDT). The interrelationships among the five human resource technologies are identified and a methodology to apply them throughout weapon system acquisition is developed. The methodology, the coordinated human resource technology (CHRT), when applied. quantifies the reliability, maintainability. manpower, training, and job guide documentation requirements for a weapon system and allows these factors to influence design. maintenance. operations. and support concepts early in acquisition. CHRT also provides a means to estimate ownership cost.

This document is one volume of a three-volume report. namely:

AFHRL-TR-78-6(I) *Integration and Application of Human Resource Technologies in Weapon System Design: Coordination of Five Human Resource Technologies*

AFHRL-TR-78-6(II) *Integration and Application of Human Resource Technologies in Weapon System Design: Processes for the Coordinated Application of the Five Human Resource Technologies*

AFHRL-TR-78-6(III) *Integration and Application of Human Resource Technologies in Weapon System Design: Consolidated Data Base Specification for the Coordinated Application of the Five Human Resource Technologies (72 pp)*

8 Goclowski, J.C., King, G.F., Ronco, P.G., & Askren, W.B. Integration and application of human resource technologies in weapon system design: Processes for the coordinated application of five human resource technologies. AFHRL-TR-78-6(II). AD-A053 681. Wright-Patterson AFB, OH: Advanced Systems Division. March 1978. Project 1959. Contra   F33615-77-C-0016. Dynamics Research Corporation. NTIS. The four basic activities of a coordinated human resource technology are described. The first is the consolidated data as development which processes source data. The second is the integrated requirements and ask analysis (IRTA) which determines human resource requirements. The third is ISD/JGD product development The fourth is the impact analysis which provides human resource and cost data on any specific configuration or alternative. It is through this activity that CHRT may influence the selection of design, maintenance operations and support alternatives.

This document is one volume of a three-volume report, namely:

AFHRL-TR-78-6(I) *Integration and Application of Human Resource Technologies in Weapon System Design. Coordination of Five Human Resource Technologies*

AFHRL-TR-78-6(II) *Integration and Application of Human Resource Technologies in Weapon System Design: Processes for the Coordinated Application of the Five Human Resource Technologies*

AFHRL-TR-78-6(III) *Integration and Application of Human Resource Technologies in Weapon System Design: Consolidated Data Base Specification for the Coordinated Application of the Five Human Resource Technologies (72 pp.)*

9 Goclowski, J.C., King, G.F., Ronco, P.G., & Askren, W.B. Integration and application of human resource technologies in weapon system design: Consolidated data base functional specification. AFHRL-TR 78-6(III). AD-A059 298. Wright-Patterson AFB, OH: Advanced Systems Division, May 1978. Project 1959, Contract F33615-77-C-0016, Dynamics Research Corporation. NTIS. The consolidated data base required to support the application of the coordinated human resource technology (CHRT) on a weapon system acquisition program is described in this functional specification. The major categories of data stored in the consolidated data base relate to reliability, maintainability, maintenance manpower, operations manpower, training, and job guides for both maintenance and operations, and system ownership costs. The consolidated data base may also be used for operational and support planning after deployment. As developed for application, the consolidated data base is unique to each weapon system It expands in detail with time as the weapon system acquisition cycle progresses. The consolidated data base is dynamic in nature representing alternatives being considered as well as baseline approaches. It has, therefore, been designed for frequent update and expansion. This functional specification describes the content of the consolidated data base, and the processes for updating and expanding the data base (74 pp.)

10 Kaskowitz, D., & Suppes, P. Development and implementation of a computer model for student management: Phases I and II. AFHRL-TR-78-7, AD-A057 930, Lowry AFB, CO: Technical Training Division, March 1978. Project 1121, Contract F33615-77-C-0041, Stanford University, NTIS. This report describes the results of the first two phases of a study to develop and evaluate models of student progress on a technical training course being offered in a computer managed instructional environment at Lowry Air Force Base, Colorado. Several categories of models were developed in Phase I The categories were defined by model type and by the type of variables used as predictor.

In Phase II, the models were evaluated using data collected on 368 students in an inventory management course. The evaluation consisted of parameter estimation and derivation of goodness of fit statistics. The results indicated that by using the performance information on the initial blocks of the course, more precise predictions of course completion time can be made than when only preassessment data are used. (62 pp.)

11 Irish, P.A., III, & Buckland, G.H. Effects of platform motion, visual and G-seat factors upon experienced pilot performance in the flight simulator. AFHRL-TR-78-9, AD-A055 691. Williams AFB, AZ: Flying Training Division, June 1978. Project 1123. NTIS. The objective of this study was to empirically assess the performance of experienced pilots in the Advanced Simulator for Pilot Training (ASPT) under varying platform motion, G-seat, field-of-view and ceiling/visibility conditions. Five experienced T-37 pilots flew fire contact and instrument maneuvers in the ASPT under all combinations of the independent variables. Automated performance measures based on system parameters, pilot inputs and derived scores were collected and analyzed. The results indicated that expert performances were affected by the motion, field-of-view and ceiling/visibility variables and were often manifested as changes in control behavior rather than vehicle performance. (44 pp.)

12 DeVany, A.S., Saving, T.R., & Shughart, W.F., II. Supply rate and equilibrium inventory of Air Force enlisted personnel: A simultaneous model of the accession and retention markets incorporating force level constraints. AFHRL-TR-78-10, AD-A058 097. Brooks AFB, TX: Occupation and Manpower Research Division, May 1978. Project 2313. Contract F33615-77-C-0056. Resources Research Corporation. NTIS. The objective of this research is to develop and test a general model of the Air Force manpower market. Previous studies of manpower supply have had mixed results, some even indicating that enlistments are negatively related to the Air Force wage. This study indicates that previous work failed to account for the simultaneous determination of enlistments and retentions and so has misinterpreted their regressions as supply equations when they are, in reality, reduced form equations resulting from the joint interaction of Air Force demand and enlistment supply activity.

A stochastic process model is used to represent the Air Force manpower market. The variables which determine the levels of the steady state manpower inventory, personnel turnover and new enlistment flows are the mandated force level requirement, Air Force and civilian wages, the unemployment rate and the perceived civilian returns to Air Force provided training. Because both the enlistment rate as well as the planned duration of service are treated in the model it is possible to trace the impact of changes in the determining variables upon retention and enlistments.

The empirical work rejects the standard regression "supply" approach and supports the simultaneous demand and supply approach developed in the study. The results indicate that: (a) changes in the force level account for the bulk of the changes in enlistment rates during the all volunteer force period. (b) higher Air Force wages have improved retention and reduced demand for new enlistments thereby leading to lower observed accession rates. (c) improvement in civilian job opportunities and wages reduce retention, increase enlistment demand and the new accessions show somewhat lower Air Force Qualifications Test scores, and (d) previous estimates of military manpower supply elasticities are shown to be biased downward from the true elasticity. (100 pp.)

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13 LeMaster, W.D., & Longridge, T.M., Jr. Area of interest/field-of-view research using ASPT. AFHRL-TR-78-11, AD-A055 692. Williams AFB, AZ: Flying Training Division, May 1978. Project 1123. NTIS. Two exploratory experiments were conducted in the Advanced Simulator for Pilot Training to examine the head-slaved area of interest (AOI) approach for reduced fields-of-view employing computer-generated imagery (CGI). The objective of Study 1 was to establish a suitable range of AOI sizes for simulated conventional gunnery range bombing performance. The results indicated an AOI size as small as 70° vertical x 90° horizontal could be usefully employed without seriously degrading bombing performance.

The objective of Study 2 was to determine the effect of AOI level of detail on air-to-surface weapon delivery performance in a tactical environment. Study 2 also addressed the question of whether AOI size affected bombing performance in such an environment. No effects on bombing performance of either detail level, AOI size or their interaction were observed. It was concluded from both studies that an AOI size as small as 70° x 90° is feasible for the head-slaved AOI approach. Further research on required detail level is needed. (22 pp.)

14 Pritchard, R.D., & Montagno, R.V. Effects of specific vs. nonspecific and absolute vs. comparative feedback on performance and satisfaction. AFHRL-TR-78-12, AD-A055 693. Brooks AFB, TX: Occupation and Manpower Research Division, May 1978. Project 2313. AFOSR Grant 76-2873. Purdue Research Foundation. NTIS. The first portion of this report focused on intrinsic motivation as a possible approach to improving the motivation and productivity of Air Force personnel. While it was acknowledged that our knowledge of intrinsic motivation is limited, it was concluded that the use of intrinsic determiners offers great potential for improving motivation, and hence productivity. A list of these factors was generated from reviewing the literature and by intuitive analysis. For this report, performance feedback was selected for further study. Various dimensions of feedback were then identified and defined. In addition, a number of psychological processes were outlined in terms of their possible relationships with feedback. Two dimensions of feedback were then selected and manipulated in an experimental setting.

The first dimension, specificity, varied the amount of information subjects received about the types of errors they made. The second dimension was absolute versus comparative feedback. Subjects were either given only their own performance data or their own plus their relative standing in their work group. Results showed a positive effect for feedback on both performance and errors. Nonspecific feedback was found to contribute most to increases in performance and reduction in errors, and within the nonspecific condition comparative was found to be superior. Results are also presented which attempt to explain the findings in terms of the psychological processes outlined earlier. It was concluded that increasing performance feedback shows good potential for ultimately enhancing productivity in Air Force field settings. (60 pp.)

15 Ree, M.J. Automated test item banking. AFHRL-TR-78-13, AD-A054 626. Brooks AFB, TX: Personnel Research Division, May 1978. Project 7719. NTIS. A computer-based item storage and test construction system was developed, implemented, and tested for accuracy of estimates. The test consisted of determining item statistics on one group, constructing a test interactively, scoring the test on another group, and comparing the estimated and observed test statistics. These comparisons indicated that the estimation procedures were sufficiently exact to permit a test constructor to have knowledge of the characteristics of a test prior to administering the test. (20 pp.)

16 Gott, C.D. HIER-GRP: A computer program for the hierarchical grouping of regression equations. AFHRL-TR-78-14, AD-A058 415. Brooks AFB, TX: Computational Sciences Division, June 1978. Project 6323. NTIS. This report describes the technical details required for using the HIER-GRP computer program as it is currently operational on the Univac 1108 computer system at the Computational Sciences Division, Air Force Human Resources Laboratory, Brooks Air Force Base, Texas. HIER-GRP (or one of the earlier versions of the program) has been used extensively by the Air Force in the past, especially in conjunction with "policy-capturing applications." and many of those applications are referenced herein. The report contains a discussion of the basic algorithm, an outline of the essential steps, specifications of the computer system requirements, descriptions of necessary control cards, and explanations of the program output. Also, appendices are included that contain the mathematical formulas used, some mathematical background helpful for understanding the algorithm, sample output, and a complete source card listing. (70 pp.)

17 Martin, E.L., & Waag, W.L. Contribution of platform motion to simulator training effectiveness: Study I — Basic contact. AFHRL-TR-78-15, AD-A058 416. Williams AFB, AZ: Flying Training Division, June 1978. Project 1123. NTIS. A transfer-of-training design was used to evaluate the contributions of simulator training with a synergistic six-degree-of-freedom platform motion system to the acquisition of basic contact, approach and landing skills. Twenty-four Undergraduate Pilot Trainees were divided into three groups: (a) Motion, (b) No Motion. and (c) Control. The Motion and No-Motion groups received ten instructional sorties in the Advanced Simulator for Pilot Training (ASPT) on a large number of basic contact tasks ranging in complexity from Straight-and-Level to the normal Overhead Pattern and Traffic Pattern Stalls. Both groups received the same amount of training on each task. The only difference in training condition between the two groups was the presence or absence of motion cues provided by the platform system. (The G-seat was not used.) All tasks were taught using the full field-of-view available on the ASPT's computer-generated image visual system. The students in the Control group received the standard pre-flight training (i.e.. no ASPT pretraining). Student performance during the simulator training phase was assessed by Instructor Pilot ratings of task performance and automated objective performance measures.

Two indices of transfer value were used. Short-term transfer was assessed for the Motion and No-Motion groups on the first and the fifth T-37 missions. Mission scenarios were designed to include all tasks taught during the simulator training phase. Student performance on each task was evaluated by instructor pilot ratings. Long-term measure transfer effects were provided by the task frequency data collected on selected tasks for students in all three groups on approximately their first 20 aircraft flights (through solo).

The major findings of the study are: (a) no differences in simulator performance between the Motion and No-Motion groups; (b) significant learning occurred during simulator training for both groups, (c) no difference in performance between the Motion and No-Motion groups for any of the tasks on the two special data sorties flown in the T-37; (d) no significant differences were found between the Motion and No-Motion groups in the task frequency data. although there was a trend for the Motion group to perform slightly better; (e) the two groups trained in the ASPT performed significantly better than the control group on all of the more advanced tasks. The results of this study establish the potential training value of the modern generation ground-based trainers. However, the data failed to reveal any significant or practical enhancement of training effectiveness as a result of the addition of platform motion. (10 pp.)

18 Thorpe, J.A., Varney, N.C., McFadden, R.W., LeMaster, W.D., & Short, L.H. Training effectiveness of three types of visual systems for KC-135 flight simulators. AFHRL-TR-78-16, AD-A060 253. Williams AFB, AZ: Flying Training Division, June 1978. Project 1123. NTIS. The objective of this study was to determine the relative training effectiveness of three generic types of simulator visual systems for application to KC-135 Combat Crew Training School (CCTS): A TV/Model Board system (TV), a Day/Night Color Computer Generated Imagery (CGI) system (Day), and a Night Only/Point Light Source CGI (Night). This study was designed to identify any deficiencies associated with these three systems which might adversely impact training.

The comparative effectiveness data for the three visual systems was generated using a transfer-of-training design. Subjects were 30 recent graduates of UPT transitioning into the copilot position of the KC-135. They were divided into three equal groups, each receiving simulator training on one of the three visual systems.

Each student received up to eight hours of instruction in the simulator (mean training time: 6.57 hours) with instruction by SAC KC-135 IPs scheduled over a 2-day period. Following simulator training, each student flew two evaluation sorties in the KC-135 aircraft with three to four landings attempted on each sortie.

Simulator Results: All subjects demonstrated an increase in flying skill during simulator training. Comparison of group mean times in the simulator required to meet a specified proficiency criterion did not reveal any differential efficiency (time required to meet proficiency) among the three systems.

Evaluation Flight Results: A comparison of evaluation flight scores revealed that the Night and Day systems trained more effectively than the TV system. The TV system trained less effectively in the final approach glidepath segment of the landing task. No serious deficiencies were identified in the Day and Night system which might adversely affect the quality of training.

Follow on CCTS Training Results: Sixty percent of the simulator trained students received the "Highly Qualified" score on their checkride landings, while only thirty percent of CCTS students normally receive this score. Instructor pilots reported a generally higher skill level from the students who had received simulator training in this study. (46 pp.)

19 Bebeau, M.J., & Sullivan, H.J. Effects of student-preferred incentives in university courses. AFHRL-TR-78-17, AD-A059 741. Williams AFB, AZ: Flying Training Division, May 1978. Project 2313, Contract F41609-75-C-0028, Arizona State University. NTIS. Three experiments were conducted to determine the effects of student-preferred incentives across instructional tasks that varied in length and relatedness to the course content. Dependent measures included posttest performance, study time, and student reports of effort. The incentives selected for use in each experiment were based upon recent normative data on incentive preferences of university students. Sixty-four undergraduates enrolled in an upper-division education course participated in Experiments 1 and 2. In the first study, the opportunity to earn points toward the course grade for acceptable posttest performances was used as an incentive. No significant differences between incentive and no-incentive students were obtained on any dependent measure for either a course-related or a non-course-related instructional program. In the second study, performance of students, each of whom was allowed to select his or her preferred incentive from among several alternatives, was compared with performance of students in a no-

incentive treatment on two course-related instructional programs. Incentive students performed significantly ($p < .004$) better than no-incentive students on certain program subtests—subtests that required the student to state lists of rules that could be committed to memory. In Experiment 3, the effect on student performance of release from final examination was investigated under typical instructional conditions in a university course. Fifty-nine students studied self-instructional materials and attended optional practice sessions during a three-week unit of instruction that was a regular part of the course. In this experiment, students in the no-incentive condition scored significantly higher ($p < .04$) on a constructed-response subtest that required new applications of rules than did students in the incentive condition. As in a typical course, posttest scores were applied to the course grade for all students, but only students in the incentive condition could earn release from the final examination for acceptable performance on the test. One finding from Experiment 2 relates to the selection of incentives for classroom use. Grade-related and non-grade-related incentives were described in this experiment in a manner designed to have high appeal for students enrolled in the course. The sharply lower ratings given potential incentives that were not grade-related (e.g., assisting the instructor, attending a small group discussion with an authority on a high-interest topic) was consistent with earlier normative ratings of potential incentives obtained by the author from university students in psychology and education courses. However, points toward the course grade were preferred over release from a rather comprehensive final assignment in the present study, whereas subjects in the normative studies had rated release from the final examination higher than points toward the course grade. Evidence from these experiments and previous research indicates that incentives are effective for memory-type tasks, particularly when the student is aware that rehearsal and memory are task requirements. The unanticipated negative effect of incentives in Experiment 3 on a task that required new applications of rules suggests a need for additional investigations of the generalizability and reliability of this effect. (56 pp.)

20 Albery, W.B., & Hunter, E.D. G-seat component development. AFHRL-TR-78-18, AD-A055 533. Wright-Patterson AFB, OH: Advanced Systems Division, June 1978. Project 6114. NTIS. An effort was conducted to investigate the improved performance of a closed-loop G-seat system. The Air Force and Navy are currently using G-seats in several training and fighter simulators. These devices are all open-loop systems and exhibit excessive time delays. While these seats exhibit good sustained cueing capability, their performance is marginal in producing overall acceleration cues. Because of sluggish response characteristics, virtually none of the seats can give appropriate acceleration onset cues and be in synchronization with current visual systems. Conventional G-seat components were obtained as well as advanced, position feedback metal bellows, and a closed-loop pneumatic control system was designed and developed. The open- and closed-loop performance of this system was evaluated and the contribution of each component in the G-seat hardware was analyzed. Transfer functions were developed for the pneumatic control system. (32 pp.)

21 Sauer, D.W., & Askren, W.B. Validation of an expert estimate technique for predicting manpower, maintenance, and training requirements for proposed Air Force systems. AFHRL-TR-78-19, AD-A058 851. Wright-Patterson AFB, OH: Advanced Systems Division, May 1978. Project 1124, Contract F33615-76-C-0042, Systems Research Laboratories, Incorporated. NTIS. The objectives were to determine the validity of an expert estimate technique for predicting manpower, maintenance, and training requirements for equipment in the early

stages of design, and to develop a guide for implementing the technique. Sixty Air Force technicians from two avionics Air Force Specialty Codes participated as expert estimators. Twenty of these technicians were also qualified avionics instructors. The 60 technicians made estimates of manpower, maintenance, and training requirements using only an engineering description of an operational avionics component. The description contained information available during the early design stages of the component. The accuracy of the estimates was determined by comparing them with manpower, maintenance, and training data associated with the operational equipment. The results indicate that maintenance task time, crew size, skill level, career field, and task difficulty can be estimated with a satisfactory degree of accuracy. Training times were greatly overestimated. The estimates of required training facilities/equipment and the impact of design features on maintenance were nonconclusive. The results also indicate that ten technicians with skill level 5 and with system experience on equipment similar to the proposed equipment will produce acceptable estimates. A prototype guide for using the technique was prepared. (38 pp.)

22 Sauer, D.W., & Askren, W.B. Validation of an expert estimate technique for predicting manpower, maintenance, and training requirements for proposed Air Force systems: Appendix A. AFHRL-TR-78-19(Supplement I), AD-A058 852. Wright-Patterson AFB, OH: Advanced Systems Division, May 1978. Project 1124, Contract F33615-76-C-0042, Systems Research Laboratories, Incorporated. NTIS. The objectives were to determine the validity of an expert estimate technique for predicting manpower, maintenance, and training requirements for equipment in the early stages of design, and to develop a guide for implementing the technique. Sixty Air Force technicians from two avionics AFSCs participated as expert estimators. Twenty of these technicians were also qualified avionics instructors. The 60 technicians made estimates of manpower, maintenance, and training requirements using only an engineering description of an operational avionics component. The description contained information available during the early design stages of the component. The accuracy of the estimates was determined by comparing them with manpower, maintenance, and training data associated with the operational equipment. The results indicate that maintenance task time, crew size, skill level, career field, and task difficulty can be estimated with a satisfactory degree of accuracy. Training times were greatly overestimated. The estimates of required training facilities/equipment and the impact of design features on maintenance were nonconclusive. The results also indicate that ten technicians with skill level 5 and with system experience on equipment similar to the proposed equipment will produce acceptable estimates. A prototype guide for using the technique was prepared. (54 pp.)

23 Fisher, C.D., & Pritchard, R.D. Effects of personal control, extrinsic rewards, and competence on intrinsic motivation. AFHRL-TR-78-20, AD-A058 417. Brooks AFB, TX: Occupation and Manpower Research Division, July 1978. Project 2313, AFOSR Grant 76-2873, Purdue Research Foundation. NTIS. This report investigated three of the possible determinants of intrinsic motivation identified by Pritchard and Montagno (1978) in an earlier phase of this project. The three variables of concern were feelings of personal control, feelings of competence, and type of extrinsic reward system.

A literature review revealed that the effects of personal control on intrinsic motivation had never been evaluated, that a suggested interaction of competence and personal control had not yet been investigated, and that studies comparing the effects of contingent versus noncontingent reward systems on intrinsic motivation had produced conflicting results and conclusions. Further, most of the research reviewed had been conducted under laboratory conditions which limit its generalizability to actual jobs in Air Force enviroments.

Therefore, a study was designed wherein personal control over performance and payment systems were manipulated in a simulated work setting. It was found that personal control was a very important determinant of intrinsic motivation but that type of payment system did not affect intrinsic motivation in the work setting. An interaction between personal control and competence was found such that both performance and personal control had to be high in order for intrinsic motivation to be high. The implications of these results for job design were discussed. (24 pp.)

24 Pritchard, R.D., & Shaw, J.B. Comparison of published measures of job satisfaction on a taxonomy of job rewards. AFHRL-TR-78-21, AD-A058 138. Brooks AFB, TX: Occupation and Manpower Research Division, July 1978. Project 2313, AFOSR Grant 76-2873, Purdue Research Foundation. NTIS. The present study was part of a larger effort to explore the job satisfaction-reward-performance linkages. The overall logic of the work is that rewards influence both the level of satisfaction a person feels towards his work and the performance exhibited by that person on the task.

The present study was directed toward the accomplishment of 4 specific objectives:

1. To develop a comprehensive list of job rewards.
2. To develop, in particular, a list of rewards of an intrinsic nature.
3. To compare published measures of job satisfaction.
4. To compare, in particular, the Air Force Occupational Attitude Inventory against other measures of satisfaction.

A number of sources were used in developing the taxonomy of job rewards. The final list consisted of six major categories (General Organizational Rewards, Task, Interaction With Others, Extrinsic Rewards, External Rewards, and Overall Job Satisfaction). Within a major category there were also a number of subcategories as well as a very large number of specific reward areas. A considerable number (35) of intrinsic rewards were listed within the major category of "Task," under the categories of "intrinsic rewards" and "personal control."

Once the list of job rewards was complete, eighteen measures of job satisfaction were compared as to the degree which they either fully or partially covered each of the major categories, subcategories, and specific reward areas. Included among these measures was the Air Force Occupational Attitude Inventory (OAI). By far the most comprehensive measures were the OAI, which covered 107 specific reward areas, and the Minnesota IRC Satisfaction scales, which covered 90 specific reward areas. In addition, the OAI covered 13 of 15 subcategories and the Minnesota Scales covered 12 of 15 categories. (28 pp.)

25 Crosby, J.V., Pohlmann, L.D., Leshowitz, B., & Waag, W.L. Evaluation of a Low Fidelity Simulator (LFS) for instrument training. AFHRL-TR-78-22, AD-A058 139. Williams AFB, AZ: Flying Training Division, July 1978. Project 2313. NTIS. The objective of this study was to investigate the transfer of training from a low fidelity simulator (LFS) to a higher fidelity device, and subsequently to the aircraft. An attempt was made to determine both the magnitude of transfer, as well as the temporal duration of the effect. A transfer of training design was employed using 14 students entering Undergraduate Pilot Training (UPT). Subjects were divided into two equal groups (n =7). One group received pretraining on the LFS, while the other did not. LFS training consisted of 10 hours of basic instrument instruction conducted over a 2-week period prior to UPT entry During LFS training, students were advanced on a proficiency basis, using objectively derived scoring procedures.

Upon entering the UPT program, both groups were required to fly an evaluation sortie in the Advanced Simulator for Pilot Training (ASPT). The sortie consisted of two repetitions of six instrument flight maneuvers. All students then entered normal T-4 instrument training, during which task frequency data were collected. Prior to entry into the T-37 aircraft training phase, both groups again flew the same evaluation sortie in the ASPT. Task frequency data were then collected in the T-37 up to each student's first solo flight.

On the initial evaluation sortie in the ASPT, the LFS-trained group performed significantly better than the control group across all maneuvers. Analysis of the collected data during T-4 training revealed significantly fewer trials to criterion for the experimental groups. On the second ASPT sortie, however, no differences were found between the groups. Likewise, the data collected during T-37 training revealed no differences.

The results indicated a considerable amount of positive transfer at the onset of the UPT program. These initial performance differences, however, appeared to wash out following approximately one month of academic and T-4 simulator training. Beyond this point, no differences between the two groups could be detected. (14 pp.)

26 Grunzke, P.M. Evaluation of the automated adaptive flight training system's air-to-air intercept performance measurement. AFHRL-TR-78-23, AD-A060 320. Williams AFB, AZ: Flying Training Division, July 1978. Project 1123. NTIS. The objectives of this study were: (a) to assess the effectiveness of the Automated Adaptive Flight Training System's (AAFTS) performance measurement package; and (b) to evaluate the efficiency of Operational Test and Evaluation (OT& E) procedures developed as a data-gathering tool for performance measurement.

In conjunction with TAC and USAFTAWC, AFHRL/FT carried out the requirements of the OT& E for the AAFTS device, in accordance with TAC Project 74A-119U. Annex A. A total of twelve crews, five student and seven operational, flew the F-4E WSTS #15/AAFTS simulator system located at Luke AFB, Arizona. Crews flew and were scored on nine different types of air-to-air intercepts that were programmed into the AAFTS device. The data revealed significant differences favoring the operational crews in two types of attacks (single turns and stern conversions). The AAFTS device, which utilized a 28-variable scoring format, was also examined on a variable-by-variable basis to observe performance differences between operational and student crews. Of the 28 variables measured, three were significantly different, two of which indicated superior performance by student crews. The data warranted the following conclusions:

1. As an instructional tool, the AAFTS has the potential to provide standardized objectively scored, training/evaluative scenarios for aircrews. The AAFTS functions as an autonomous programming device that directs aircrews through an air-to-air syllabus, a feature which could be the beginning point for automating aircrew training.

2. The performance measurement package performed adequately as an informational feedback tool, but requires more research to select and validate variables that discriminate better between aircrew skill levels. Failure to discriminate between skill levels could have occurred because the variables and their weights were based on the opinions of subject matter experts, not determined empirically.

3. Use of OT& E procedures was minimally effective for performance measurement but served well as a means for acquiring aircrew subjective impressions on the system's overall training/ evaluation potential. (32 pp.)

27 Foley. J.P., Jr. Executive summary concerning the impact of advanced maintenance data and task oriented training technologies on maintenance, personnel, and training systems. AFHRL-TR-78-24, AD-A053 682. Wright-Patterson AFB, OH: Advanced Systems Division, March 1978. Project 1710. NTIS. This paper is an executive summary of a more extensive white paper concerning the *impact* of improved maintenance guidance and information (IMG& I), as well as task oriented training (TOT) technologies *on* DOD maintenance, personnel and training systems. The IMG& I considered include full proceduralized job performance aid (FPJPA) technology for both non-troubleshooting (non-TS) and troubleshooting (TS) tasks: the Army "New Look" for non-TS tasks: and for TS tasks only: traditional and enriched FORECAST aids, traditional and e   :ed logic tree troubleshooting aids (LTTA), and traditional and Air Force symbolic inte͞   m͞intenance system (SIMS), as well as a newer form of SIMS called functionally oriente   aintenance manuals (FOMM).

However, the technologies or concepts, whose effectiveness are supported by comparative hard data, include only: FPJPA. FORECAST aids, enriched LTTA, and AF SIMS. These hard data indicate that quality implementations of any of these technologies (or concepts) will result in more efficient performance of maintenance tasks than the use of traditional maintenance manuals (TMM). (In this regard, there are no hard data which indicate that FOMMs are more effective that AF SIMS.) But, by far the most dramatic reductions of life cycle costs (LCC) of hardware ownership can be realized by the quality integrated application of three of these types of IMG& I with TOT; i.e., FPJPA. FORECAST TS Aids and enriched LTTA. Of these, FPJPA have the most potential.

This executive summary also indicates a number of human. hardware and software problems, and policies which are impeding, or will impede, the implementation of these money saving technologies. Although dramatic LCC reductions can be effected by the quality implementation of IMG& I and TOT technologies, such implementations require greater dollar investments in maintenance guidance documents and in training than the implementing establishments are accustomed to spend. But additional money is not enough-quality implementations require "know how." A mechanism must be developed which makes efficient and effective use of the "know how" of the developers of the technologies. and makes them responsible and accountable for their early implementations. In this regard, most past implementations have "watered down" such technologies.

Of special interest to executives and managers are two tables which consolidate the important attributes of various IMG& I types and TMM: a figure which summarizes the results of many DOD TOT studies: and a flow diagram which portrays a model for maximizing benefits of FPJPA. SIMS. and TOT technologies. (26 pp.)

28 Foley, J.P., Jr. Impact of advanced maintenance data and task oriented training technologies on maintenance, personnel, and training systems. AFHRL-TR-78-25, AD-A063 277. Wright-Patterson AFB, OH: Advanced Systems Division, September 1978. Project 1710. NTIS. This report and its executive summary (AFHRL-TR-78-24) concern the impact of improved maintenance guidance and information (IMG& I), as well as task oriented training (TOT) technologies on DOD maintenance. personnel and training systems. The IMG& I considered include fully proceduralized job performance aid (FPJPA) technology for both non-troubleshooting (non-TS) and troubleshooting (TS) tasks: the Army "New Look" for non-TS tasks: and for TS tasks only: the traditional and enriched FORECAST aid. traditional and enriched logic tree troubleshooting aid (LTTA), and traditional and Air Force symbolic integrated maintenance system (SIMS). as well as a newer form of SIMS called the functionally oriented maintenance manuals (FOMM).

However, the technologies or concepts, whose effectivene: s supported by comparative hard data, include only: the FPJPA, FORECAST aid, enriched LTTA, and AF SIMS. These hard data indicate that quality implementation of any of these technologies (or concepts) will result in more efficient performance of maintenance tasks than the use of the traditional maintenance manual (TMM). (In this regard, there are no hard data which indicate that the FOMM is more effective than the AF SIMS.) But, by far the most dramatic reductions of the life cycle cost (LCC) of hardware ownership can be realized by the quality integrated application of three of these types of IMG& I with TOT: i.e., FPJPA, FORECAST TS Aid, and enriched LTTA. Of these, the FPJPA has the most potential.

Much of the executive summary and the body of the white paper are similar in organization and content. However, the white paper contains a more complete treatment of human, hardware, and software problems, and policies which are impeding, or will impede, the implementation of these money saving technologies. Although dramatic LCC reductions can be affected by the quality implementation of IMG& I and TOT technologies, such implementations require greater dollar investments in maintenance guidance documents and in training than the implementing establishments are accustomed to spend. But additional money is not enough—quality implementations require "know how." A mechanism must be developed which makes efficient and effective use of the "know how" of the developers of the technologies, and makes them responsible and accountable for their early implementations. In this regard, most past implementations have "watered down" such technologies.

Of special interest to executives and managers are two tables which consolidate the important attributes of various IMG& I types and TMM: a figure which summarizes the results of many DOD TOT studies; and a flow diagram which portrays a model for maximizing benefits of FPJPA, SIMS, and TOT technologies.

The white paper also contains a number of appendices which summarize most of the DOD studies which have produced hard data concerning various IMG& I. Other appendices describe and discuss TMM and the various IMG& I as well as military and industrial applications of IMG& I and TOT. (66 pp.)

29 Lish, P.A., III. & Brown, J.E. Subjective motion discrimination in the simulator for air-to-air
    c   bat. AFHRL-TR-78-26, AD-A059 742. Williams AFB, AZ: Flying Training Division, August
        . Project 1123. NTIS. The primary objective of this study was to acquire subjective
        mation on the ability of pilots to perceptually differentiate between selected conditions of
    mo jn cueing in the Simulator for Air-to-Air Combat (SAAC). A second objective was to
    prepare the initial framework for follow-on studies designed to determine the contributions of
    motion cueing to pilot performance and training in the SAAC. Four high experience F-4 pilots
    and four low experience F-4 pilots flew six contact maneuvers in the SAAC under eight
    experimental conditions of platform motion. G-seat, and G-suit. Subjective ratings were
    collected from the pilots on the effectiveness of the motion-cueing systems after the completion
    of each maneuver. The results indicated that the pilots could discriminate changes in G-suit
    performance via the ratings. However, no differences in the pilot ratings were elicited by
    changes in the G-seat or platform motion system operation. (34 pp.)

30 Fink, C.D., & Shriver, E.L. Simulators for maintenance training: Some issues, problems and
    areas for future research. AFHRL-TR-78-27, AD-A060 088. Lowry AFB, CO: Technical Training
    Division, July 1978. Project 2361. Contract F33615-77-C-0051, Kinton, Incorporated. NTIS.
    This report reviews past and present applications of simulation to maintenance training.

Emphasis is on describing issues, problems and areas for future research as identified by recent authors. A variety of issues and problems are discussed under _ve headings—Application of Simulation Technology to Technical Training, Determination of Simulation Requirements, Design and Specification of Simulation Requirements, User Acceptance of Maintenance Simulators, and the Cost Effectiveness of Maintenance Simulators. Requirements for future research are discussed under the following topics: Evaluating the Cost Effectiveness of Simulators; Comparing Simulators One With Another; Determining Training Requirements; Determining Simulation Requirements; Developing Exemplary Simulators; Developing Exemplary Mixes of Maintenance Training Media; Obtaining User Acceptance; Developing Improved Regulations for Maintenance Simulators. (62 pp.)

31 Hannaman, D.L., Freeble, L.A., & Miller, G.G. Description of the Air Force maintenance training device acquisition and utilization processes. AFHRL-TR-78-28, AD-A059 743. Lowry AFB, CO: Technical Training Division, August 1978. Project 2361, Cont .et F33615-77-C-0052, Kinton, Incorporated. NTIS. The purpose of this study was to obtain a definition of the Air Force Maintenance Training Device Acquisition and Utilization process as a realistic baseline for the development of a cost-effective training equipment research and development program. Relevant Air Force documentation was reviewed and the functions, procedures, and interfaces of the system were described. Data were also collected through interviews at major Commands and HQ USAF. A model of the system was developed from these sources. The life cycle concept was used as a framework for describing the process in five phases: (1) identification of requirements, (2) development of specifications, (3) procurement, (4) obligation and support, and (5)retirement. A major conclusion of the study was that procedures exist for the introduction of new technology training devices if the procurement is tied to the normal system acquisition process, but that there are specific difficulties when the training equipment is for systems no longer under systems acquisition (i.e., program management has been shifted from Air Force Systems Command to Air Force Logistics Command). (86 pp.)

32 Magarinos, J.R. Holographic volume-phase, 17-inch aperture, on-axis, spherical beamsplitter mirror: Development of. AFHRL-TR-78-29, AD-A058 339. Wright-Patterson AFB, OH: Advanced Systems Division, August 1978. Project 1958, Contract F33615-76-C-0041, Farrand Optical Co., Incorporated. NTIS. This project was to develop a holographic, spherical beamsplitter mirror, utilizing a high power continuous wave laser. The holographic beamsplitter mirror would be used in a Pancake Window system, replacing the classical beamsplitter mirror which is expensive to manufacture and is the heaviest element. Techniques that were investigated involved the handling of high power lasers: a two-room, two-table geometry configuration: and other lesser problems, such as vibration, thermal, accoustic, and ghosts. A 17-inch aperture, holographic volume-phase, on-axis, spherical beamsplitter mirror was developed and tested in a holographic Pancake Window system. Its overall performance was not yet as good as a classical Pancake Window system, but results at certain angles were better than theoretically could be expected. It was recommended that development be continued in order to resolve problems encountered during this project and to develop a larger size holographic spherical beamsplitter mirror. (50 pp.)

33 Ward, J.H., Jr., Haney, D.L., Hendrix, W.H., & Pina, M. Assignment procedures in the Air Force procurement management information system. AFHRL-TR-78-30, AD-A056 531. Brooks AFB, TX: Occupation and Manpower Research Division. July 1978. Project 2077. NTIS. This report presents an overview of the procedure for offering jobs in the Air Force Procurement Management Information System (PROMIS). The overview was presented at the 19th Annual Conference of the Military Testing Association. San Antonio, Texas, 19 October 1977.

A general framework for viewing personnel assignment systems is presented first. Then the job offering approach is described. The procedure involves the estimation of the value to the Air Force of each possible person-job assignment. These pay-off values are derived through Policy Specifying—a variation of Policy Capturing. The pay-off generator includes consideration of the interaction between the person's aptitude and the job aptitude requirement, the predicted technical school success, the aptitude area preference, the rate of job fill, and the percentage of jobs filled by minorities. The Allocation Index used for ordering the opportunities list of jobs is based on a Decision Index which is described. Extension of the PROMIS assignment system can provide a vehicle through which human resources research findings can affect and improve individual personnel assignment. (24 pp.)

34 Klein, G.A., & Weitzenfeld, J. Improvement of skills for solving ill-defined problems. AFHRL-TR-78-31, AD-A067 815. Wright-Patterson AFB, OH: Advanced Systems Division, March 1979. Project 1710. NTIS. To develop effective programs for training people to solve general, commonly encountered problems, it is necessary to recognize that such problems are typically ill-defined and require additional goal specification. Most current training programs have developed from information processing or from Deweyan theories of problem solving. However, neither theory has provision for dealing with ill-defined problems. Current programs are therefore limited in their applicability. Solving ill-defined problems can be described in terms of two interacting processes: identifying the properties of the goal, and simultaneously attempting to find procedures for accomplishing the goal. Within this framework, goal specification is supported by the inference of goal properties from analogous problems, and by the use of unsuccessful procedures for inferring goal properties. This description of how people solve ill-defined problems was used to develop a number of implications for training programs aimed at improving problem solving abilities, such as the need to train personnel to specify goal properties initially and also continually throughout the process, special opportunities for using unsuccessful hypotheses as a source of goal properties, and the value of analogies for suggesting goal properties. (14 pp.)

35 Thomas, D.L., Johnson, R.C., & Dalezman, J.J. Opinions of Air Force maintenance personnel about conventional technical orders. AFHRL-TR-78-32, AD-A058 340. Wright-Patterson AFB OH: Advanced Systems Division, July 1978. Project 1710. NTIS. This report examined the adequacy of current Air Force technical orders (TOs) as training and job performance aids by utilizing the opinion survey method. A questionnaire measured the attitudes of C-141 aircraft maintenance technicians and personnel toward conventional TOs in order to identify problems with their use and usability. The questionnaire and procedures used were identical to those of a survey conducted in 1962. The results of the present survey indicated that the subject technicians generally identified the same problems with TOs as were identified in the field study conducted 13 years earlier: i.e., TOs frequently were difficult to understand, did not allow for easy information access, and did not provide necessary on-the-job information. The technicians in the sample suggested that TOs should provide specific step-by-step job-related instructions supported by detailed illustrations. (24 pp.)

36 Hunter, D.R., & Thompson, N.A. Pilot selection system development. AFHRL-TR-78-33, AD-A058 418. Brooks AFB, TX: Personnel Research Division, July 1978. Project 7719. NTIS. This technical report describes test instruments, including two aircrew psychomotor tests, the Automated Pilot Aptitude Measurement System, and several written tests, as predictors for success in Undergraduate Pilot Training. The report recommends implementation of a pilot selection system which includes psychomotor tests, the Automated Pilot Aptitude Measurement System, and several written tests as an effective screen for entry into undergraduate pilot training. Validities are reported for individual instruments as well as for combinations of those instruments. The importance of obtaining cost effective self-contained equipment is indicated, and recommendations for future research are given. (36 pp.)

37 Goodenough, J.B., & Braun, C.L. Simulation higher order language requirements study. AFHRL-TR-78-34, AD-A058 994. Wright-Patterson AFB, OH: Advanced systems Division, August 1978. Project 6114. Contract F33615-77-C-0029. SofTech, Incorporated. NTIS. This report defines high order language requirements for programming flight training simulators. These requirements were determined by analyzing programs written for a variety of simulators. Examples drawn from these programs are used to justify the need for certain HOL capabilities. A detailed specification of simulator HOL requirements is given, following the general structure and organization of the IRONMAN requirements for the DoD Common Language effort. PL/I, FORTRAN, JOVIAL J3B, JOVIAL J731, and PASCAL are analyzed to see how well each language satisfies the simulator HOL requirements. Although PL/I and JOVIAL J3B were found to be best suited for simulator programming, only FORTRAN was clearly the least suitable language. Since all the languages failed to satisfy some simulator requirements, we specified modifications of each language that would make them more useful as simulator programming languages. Our analysis of recommended modifications indicated that PL/I was the most easily modified language. (226 pp.)

38 Knoop, P.A. Survey of human operator modeling techniques for measurement applications. AFHRL-TR-78-35, AD-A058 327. Wright-Patterson AFB, OH: Advanced Systems Division, July 1978. Project 6114. NTIS. The purpose of this study was to review existing human operator modeling techniques and evaluate their potential utility for performance measurement applications. The major human operator characteristics that ought to be accounted for by a useful model were identified. Then existing models were categorized, surveyed, and summarized. Models in each category were evaluated based on the extent to which they represent the identified human operator characteristics as well as other aspects of their general validity for performance measurement applications. Results are that none of the models implement more than a few of the human operator characteristics; many are based on assumptions which are unacceptable for measurement applications; and others have not been developed far enough to justify their use as a point of departure for measurement. It is concluded that existing models are not sufficiently representative of known characteristics of human behavior to be useful for general applications in performance measurement. (40 pp.)

39 Wilbourn, J.M., & Alley, W.E. Pictorial interest inventory development. AFHRL-TR-78-36, AD-A060 089. Brooks AFB, TX: Personnel Research Division, August 1978. Project 7719. NTIS. Concern has arisen as to the value of written inventories in assessing interests of individuals who possess comparatively low mental ability and/or reading skills. As a solution, nonverbal or

picture inventories of interests have been developed. This study was initiated to develop a nonverbal interest inventory for use with aptitudinal information in the selection and classification of Air Force enlisted accessions.

A pictorial. nonverbal interest inventory was developed. consisting of 180 35mm color slides which cover a representative sample of Air Force jobs. During basic military training. 8,567 male and 3,296 female enlistees were administered the Pictorial Interest Inventory (PII) and Vocational Interest-Career Examination (VOICE). Eleven vocational interest scales factored for both male and female enlistees. with an additional factor (Shop Skills) factoring for males. Other vocational scales found were Electronics. Office/Administration. Medical/Dental, Aircraft/Weapons Maintenance. Pararescue. Law Enforcement. Food Service. Heavy Duty Equipment Operator. Cable/Power Line Maintenance. Air Traffic Control. and Automobile/ Aircraft Mechanic. Preferences for certain occupational scales were shown between sexes.

It was concluded that: (a) the PII can effectively identify vocational preferences of prospective enlistees in 11 areas: (b) photographs represent a viable alternative to the more traditional verbal methods in measuring interests. especially when verbal or reading abilities are in doubt: (c) individual responses to slide stimuli are interrelated in much the same manner as verbal items (VOICE): and (d) a validation of the PII with reference to job satisfaction should be performed to develop composites for counseling and assignment of prospective enlistees. (20 pp.)

40 Cream. B.W.. Eggemeier. F.T.. & Klein. G.A. A strategy for the development of training devices. AFHRL-TR-78-37. AD-A061 584. Wright-Patterson AFB, OH: Advanced Systems Division. August 1978. Project 1710. NTIS. This paper discusses the complex issues involved in the design of aircrew simulation training devices. It addresses methods for defining training requirements. fidelity. performance measurement. instructional features and crew coordination. A research evaluation of a device using these methods is presented. (16 pp.)

41 Guinn. N.. Kantor. J.E.. & Vitola. B.M. Effectiveness of adaptability screening. AFHRL-TR-78-38. AD-A060 222. Brooks AFB. TX: Personnel Research Division. August 1978. Project 7719. NTIS. A total of 12,599 basic airmen on whom aptitudinal. biographical. and History Opinion Inventory (HOI) data were collected comprised the sample population. Using the successful completion of first-term of military service as the criterion. regression analyses were accomplished to determine the effectiveness of various experimental predictor composites. Efforts were made to develop the most economical composite from the standpoint of number of data items required while retaining the maximum amount of predictive accuracy. Multiple correlations of the two composites developed from these analyses were .43 and .49. Cross-application analyses resulted in multiple correlations of .43 and .47. The effectiveness of the composites were compared to the screening effectiveness of the 1972 and 1975 standards for enlistment. Problems related to the implementation of such a screening procedure were discussed. (18 pp.)

42 Cyrus. M.L. Motion systems role in flight simulators for flying training. AFHRL-TR-78-39, AD-A059 744. Williams AFB. AZ: Flying Training Division. August 1978. Project 1123. NTIS This report reviews the literature as it relates to the use of platform motion systems in flight simulators for flying training. Motion is discussed in terms of its effect on compensatory.

pursuit, and precognitive tasks, within both the simulator and transfer contexts. Although both skilled and unskilled behaviors are addressed, the former is emphasized. The report concludes that, for most tasks, platform motion is not required to produce rapid, efficient, economical training and that other, less expensive means of imparting motion information are equally viable alternatives. The report recommends the following: (1) Whenever feasible and affordable, simulator systems should be equipped with the largest field-of-view visual system that is consistent with mission requirements, and (2) Simulators that do not include a platform motion system can be safely procured for most aircraft without compromising training effectiveness. (34 pp.)

43 Bottenberg, R.A. Relationships among factors in new officer effectiveness report system. AFHRL-TR-78-40, AD-A059 745. Brooks AFB, TX: Computational Sciences Division, August 1978. Project 6323. NTIS. To investigate the operating characteristics of performance factors and the Evaluation of Potential rating in the new Officer Effectiveness Report system, an analysis of controlled Effectiveness Reports for 9,230 lieutenant colonel ratees was carried out. The purpose of the study was to determine whether the variance of any of the performance factors was so restricted that the performance factor would not provide useful information in the rating process. Additionally, it was of interest to determine to what extent performance factor ratings are related to ratings on Evaluation of Potential and whether any of the performance factors could be eliminated from the system because they do not contribute significantly to the Evaluation of Potential. The results show that each of the 10 performance factors has a mean rating of over 4.4 on a five-point scale. More than 63 percent of all performance factor ratings are in the top block, Well Above Standard, and 23 percent in the Above Standard block. The variability on each factor is about equal. The deletion of no single performance factor from the rating system can be justified because of insufficient variance. The performance factors intercorrelated moderately among themselves and with the Evaluation of Potential rating. Taken in combination, an optimally weighted sum of performance factor ratings account for 45 percent of variance in Evaluation of Potential ratings. No single performance factor made a significant independent contribution to this level of prediction. Based on these results, it appears that raters could provide Evaluation of Potential ratings of the same quality if one or a small subset of performance factors were deleted from the system. (14 pp.)

44 Hayworth, D. Airborne electro-optical sensor simulation system. AFHRL-TR-78-41, AD-A058 835. Wright-Patterson AFB, OH: Advanced Systems Division, August 1978. Project 1958, Contract F33615-76-C-0059, General Electric Company. NTIS. The effort as documented in this report describes the total system capability. This includes a description of all the special purpose and general purpose hardware comprising the Airborne Electro-Optical Sensor Simulation (AEOSS) System. The functional relationship between hardware portions is described together with interface to the software portion of the computer image generation. Supporting rationale for selection and arrangement of hardware is also provided together with a description of the data base region. (26 pp.)

45 Meyer, R.P., Laveson, J.L. Pape, G.L. & Edwards, B.J. Development and application of a task taxonomy for tactical flying. AFHRL-TR-78-42(I), AD-A061 387. Williams AFB, AZ: Flying Training Division, September 1978. Project 1123. Contract F33615-77-C-0020. Design Plus. NTIS. A taxonomy of tactical flying skills was developed as a user oriented skill-task analysis system for practical application in solving Tactical Air Command continuation training

problems and for a behavioral data base for skill maintenance and reacquisition training research and development. Sixteen representative tactical air-to-air and air-to-surface maneuvers were analyzed and classified within the system, with provision for later expansion. A classification system was developed to accommodate the complexities of tactical flying. A data system was organized with sufficient flexibility to objectively address many areas of tactical flying. The taxonomy system also included methodology for addressing on-going training problems and requirements. (198 pp.)

46 Meyer, R.P., Laveson, J.L, Pape, G.L., & Edwards, B.J. Development and application of a task taxonomy for tactical flying. AFHRL-TR-78-42(II), AD-A061 388. Williams AFB, AZ: Flying Training Division, September 1978. Project 1123, Contract F33615-77-C-0020, Design Plus. NTIS. A taxonomy of tactical flying skills was developed as a user-oriented skill-task analysis system for practical application in solving Tactical Air Command continuation training problems and for a behavioral data base for skill maintenance and reacquisition training research and development. Sixteen representative tactical air-to-air and air-to-surface maneuvers were analyzed and classified within the system with provision for later expansion. A classification system was developed to accommodate the complexities of tactical flying. A data system was organized with sufficient flexibility to objectively address many areas of tactical flying. The taxonomy system also included methodology for addressing on-going training problems and requirements. (66 pp.)

47 Meyer, R.P., Laveson, J.L, Pape, G.L, & Edwards, B.J. Development and application of a task taxonomy for tactical flying. AFHRL-TR-78-42(III), AD-A061 478. Williams AFB, AZ: Flying Training Division, September 1978. Project 1123, Contract F33615-77-C-0020, Design Plus. NTIS. A taxonomy of tactical flying skills was developed as a user-oriented skill-task analysis system for practical application in solving Tactical Air Command continuation training problems and for a behavioral data base for skill maintenance and reacquisition training research and development. Sixteen representative tactical air-to-air and air-to-surface maneuvers were analyzed and classified within the system with provision for later expansion. (240 pp.)

48 Gould, R.B. Air Force Officer Qualifying Test Form N: Development and standardization. AFHRL-TR-78-43, AD-A059 745. Brooks AFB, TX: Personnel Research Division, August 1978. Project 7719. NTIS. Air Force Officer Qualifying Test (AFOQT) Form N was constructed as a replacement for AFOQT Form M in Fiscal Year 1978. The new form serves the same purpose as its predecessor and possesses basically the same characteristics. It yields Pilot, Navigator-Technical, Officer Quality, Verbal, and Quantitative composite scores. Two sets of conversion tables are provided for examinees' scores according to educational level. Standardization was accomplished by test administration to samples of examinees from all major sources for commissions in the Air Force and development of percentile conversion tables. Basic airmen with aptitude at or above the 50th percentile of the general population, Officer Training School candidates, Air Force Reserve Officers Training Corps students, and Air Force Academy Cadets composed the majority of the 2,681 cases in the standardization sample. Some 287 second lieutenants were also included because of the substantial number from this population who also take the AFOQT when applying for admission to special programs such as pilot or navigator training. (22 pp.)

49 Pritchard, R.D., Montagno, R.V., & Moore, J.R. Enhancing productivity through feedback and job design. AFHRL-TR-78-44, AD-A061 703. Brooks AFB, TX: Occupation and Manpower Research Division, August 1978. Project 2313, Contract F33615-77-C-0026, Purdue Research Foundation. NTIS. This research represents a study in a program to investigate potential sources of the intrinsic motivation of Air Force personnel. The first step in this process was an attempt to identify and list a number of sources of intrinsic motivation. From this list, feedback and job design were selected as sources that held promise for use in Air Force type settings. This report describes an attempt to manipulate several dimensions ˙ feedback and the degree to which a person did a complete unit of work. A job simulation was employed to experimentally test the variables finally selected. The criteria for the task used in the simulation were that it have generalizability to the Air Force and that it possess acceptable face validity for the subjects participating in the study. The task used in this study involved the processing of purchase requisitions and was designed so that subjects believed they were working on a real job and so that there were distinct quantity and quality dimensions that could be measured. The results of the study indicated that feedback has great potential for improving productivity. However, different types of feedback had markedly different effects. The best type of feedback in this study was Impersonal. High Specificity. Individual feedback in either the Public or Private format. This combination of feedback resulted in a 26% increase in quantity and a 27% decrease in errors. (48 pp.)

50 Gardner, E. Programming language CAMIL II: Implementation and evaluation. AFHRL-TR-78-45, AD-A061 620. Lowry AFB, CO: Technical Training Division, August 1978. Project 2313. NTIS. A reimplementation of computer assisted/managed instruction language (CAMIL) for qualitative and quantitative improvements in the software is presented. The reformatted language is described narratively, and major components of the system software are indicated and discussed. Authoring aids and imbedded support facilities are also described, and key CAMIL programs used in the development are discussed. The resulting system offers a method for future improvement of the Air Force Advanced Instructional System (AIS) computer support system without expenditure of additional funds for computer support. (66 pp.)

51 Ricard, G.L., Cyrus, M.L., Cox, D.C., Templeton, T.K., & Thompson, L.C. Compensation for transport delays produced by computer image generation systems. AFHRL-TR-78-46, AD-A059 857. Williams AFB, AZ: Flying Training Division, June 1978. Project 1192. NTIS. This report describes a cooperative Navy/Air Force effort aimed at the problem of image-flutter encountered when visual displays that present computer-generated images are used for the simulation of certain flying situations. Two experiments are described that extend laboratory work on delay compensation schemes to the simulation of formation flight in a research device—the Advanced Simulator for Pilot Training (ASPT). The scheme used was one where low-pass filters were added to the lead-generation software of the visual display system. Both studies were geared to determining break-points for those filters that would allow adequate flying control performance and provide an acceptable display. These experiments were based on the notion that a trade exists between the suppression of the visual image's flutter and the removal of the low frequency information necessary for flight control. One experiment represented a factorial combination of settings of the display filters and the non-visual cues of aircraft motion provided by the ASPT's g-seat and motion platform, and the second represented a simple comparison of filter settings. Both studies indicated that, at least for formation flight, there is a range of filter settings which will not adversely affect flight control and will adequately suppress visual flutter. This range represents half-power settings for the filters of 3/4 to 1 hertz. (60 pp.)

52 Mallory, W.J., & Elliott, T.K. Measuring troubleshooting skills using hardware-free simulation. AFHRL-TR-78-47, AD-A064 054. Lowry AFB, CO: Technical Training Division, December 1978. Project 1121, Contract F33615-77-C-0040, Applied Science Associates, Incorporated. NTIS. Increased emphasis on performance-oriented training in the Air Force has created a need for more valid and reliable feedback on task performance. Traditional multiple-choice tests, while reliable and easy to administer, when related to job entry performance may not possess an acceptable level of validity. The use of actual equipment for job performance testing is expensive from the investment point of view, as well as costly in terms of test administration time and its general low availability to individual students. A possible alternative is a Symbolic Performance Test (SPT). Earlier attempted SPTs have generally been part-task analogues. Performance on these earlier tests has been dissimilar to actual troubleshooting performance.

The study began with a review of past SPT efforts to determine what was done and to evaluate the strengths and weaknesses of each approach. The troubleshooting task was then analyzed to determine discrete behavioral steps and the information requirements associated with each step. The SPT concept was developed around the results of these analyses.

With the SPT concepts firmed up, the presentation mechanisms (i.e., visuals and data tables) were designed. This design dictated the parameters of SPT materials to be produced. As earlier SPT researchers have observed, providing complete operating information in symbolic form can fill volumes and require extensive production time. Equipment materials were produced once for normal equipment operation. Problem-specific information was produced only for the subset of materials affected by an individual item. Clerical production was accomplished similarly using magnetic storage for normal data and inputting only the problem-specific changes.

The SPT materials were validated prior to the full-scale data collection. The validation revealed a major problem with the answering scheme and several minor problems with the visuals. Validation personnel commented on the difficulty associated with initially learning the SPT concept and materials use. The overall concept appeared workable and the individual results matched expectations. The answering scheme and the visuals were modified. As a result of the validation, a practice problem was also developed to provide free practice prior to a subject's symbolic performance testing.

The field testing was conducted at Lowry Air Force Base, Colorado, from mid-January to mid-February 1978. Fifteen students and 16 administrators were tested in groups of four for two days each. One test administrator monitored two sets of concurrent Job Sample Tests (JSTs) and SPTs. Data collected included: answer (suspected malfunctioning stage), time to completion, steps to completion, and a record of check sequence and location.

Analysis of the results indicated similar performance on both JST and SPT forms. The accuracy scores for all subjects on all tests produced a positive correlation of .384 which is significant at the .025 level.

Time to completion produced a positive correlation of .588 which was significant at the .0005 level. Steps to completion produced a positive correlation of .356 which was significant at the .025 level.

Analysis of the check sequences and locations produced very high positive correlations between performance on JST and SPT forms.

The primary difficulty encountered was highly variable troubleshooting performance regardless of test form. This variability is illustrated by the fact that the subjects on the average missed two problems out of every three. In this regard, results were similar to those of earlier studies.

The results indicate that the SPT approach was sound. requiring very few modifications. Several new applications are suggested by the results: these include:

1. Adapting the method for computer presentation.

2. Using the method to provide practice in training. in addition to testing.

3. Using some of the SPT equipment analyses for maintenance evaluation and in curriculum development.

4. Applying the method to SPTs for other levels of troubleshooting penetration. (122 pp.)

53 Polit, D., Nuttall, R.L., & King, E. Utilization of women in industrial career fields. AFHRL-TR-78-48, AD-A066 921. Brooks AFB, TX: Personnel Research Division, October 1978. Project 7719, Contract F33615-77-C-0031, Boston College. NTIS. In an effort to expand the utilization of women in nontraditional industrial careers. this report examines relevant managerial and personnel issues and develops recommendations for Air Force policies to deal with them. The report presents a comprehensive review of the literature. an annotated bibliography. data analysis from a pilot study of three corporations. and recommendations and conclusions for the above noted sources. These recommendations include suggestions (a) to perform an organizational audit to gather baseline data on Air Force policies affecting women and to identify where the biggest problem areas are: (b) to focus part of the recruitment effort on women who are in their mid-to-late 20s: (c) to emphasize the positive aspects of nontraditional jobs such as good pay and job security: (d) to offer extensive counseling to new recruits and enlisted women: (e) to encourage those women with a reasonably high chance of success: (f) to provide compensatory instruction in mechanical and electronics information: (g) to train women in groups of two or more: (h) to sensitize key personnel to Air Force policies affecting women: (i) to communicate Air Force policies concerning women in a highly visible manner: and (j) to eliminate sexist language from all Air Force communications. (160 pp.)

54 AFHRL-TR-78-49 (This number was not assigned to a report.)

55 Steffen. D.A., Gray, G.C.. Wasmundt, K.C., & Lamos, J.P. Development of a low-cost, stand-alone microterminal for support of testing and instruction. AFHRL-TR-78-50, AD-A060 215. Lowry AFB. CO: Technical Training Division, September 1978. Project 1121, Contract F33615-77-C-0045. University of Denver. NTIS. The development of the Air Force Human Resources Laboratory Microterminal is an effort to use the new microprocessor technology to provide a lower cost student terminal which functions in the broader scope of computer-based instruction. including both Computer Managed Instruction and Computer Assisted Instruction (CAI). The capacity of the terminal to work in conjunction with conventional media (print.

filmstrip. microfiche, etc.) for presentation of information is a unique feature of its design. Another key feature is a separate memory module for storing student responses and additional program logic. The memory module is portable and removable from the microterminal. The microterminal is a stand-alone unit but interfaces with a larger Computer-Based Instruction system through the memory module. The microterminal can support various levels of testing and has already been successfully demonstrated supporting Block Testing in technical training. The microterminal, when used with conventionally mediated instructional materials. can provide a low level of CAI. This report reviews the background of the microterminal development. the hardware selected for the final design, classroom evaluations and a cost analysis. (34 pp.)

56 Monroe, E.G., Mehrer, K.L. Engel, R.L., Hannan, S., McHugh, J., Turnage, G., & Lee, D.R. Advanced Simulator for Pilot Training (ASPT): Aerial refueling visual simulation—engineering development. AFHRL-TR-78-51, AD-A063 283. Williams AFB, AZ: Flying Training Division, September 1978. Project 1123. NTIS. This report documents the engineering modifications made to the Advanced Simulator for Pilot Training (ASPT) to expand its capability to include aerial refueling simulation. These modifications include the generation of a number of KC-135 tanker models (in various levels of image detail), refueling boom. and director lights. The existing variable/slewable field-of-view program was modified to generate multiple window configurations. The on-line programs were amended to provide boom dynamics, operational director lights. and tanker flow field effects. Performance measurement techniques and a dynamic graphics display were programmed to provide an adequate means of assessing and monitoring pilot performance. (44 pp.)

57 Martin, E.L., & Waag, W.L. Contributions of platform motion to simulator training effectiveness: Study II—aerobatics. AFHRL-TR-78-52, AD-A064 305. Williams AFB, AZ: Flying Training Division, September 1978. Project 1123. NTIS. A transfer of training design was used to evaluate the contributions of simulator training with synergistic six-degrees-of-freedom platform motion to the acquisition of aerobatic skills in the novice pilot. Thirty-six undergraduate pilot trainees with no previous jet piloting experience were randomly assigned to one of three treatment group (n =12): (a) Motion. (b) No-Motion. and (c) Control. Those students assigned to the Control group received the standard syllabus of preflight and flightline instruction. The students in the two experimental conditions received five sorties. in the Advanced Simulator for Pilot Training (ASPT). covering instruction on basic and advanced aerobatic tasks. All students received the same amount of training on each task, that is, a fixed number of repetitions per task. Student performance in the ASPT was evaluated periodically throughout the pretraining phase by the use of Instructor Pilot ratings for overall task performance and of special data cards. Following three missions of instruction in the ASPT on the basic aerobatics tasks (Aileron Roll. Split "S." Loop. Lazy 8), the student advanced to the flightline for T-37 instruction. Upon completion of the basic block. the students returned for 2 ASPT instructional sorties on the advanced aerobatic tasks (Barrel Roll. Immelmann, Cuban 8. and Clover Leaf). The ASPT training was followed by the corresponding aircraft instructional block. Airborne performance was evaluated by the flightline instructor pilot using the same data card format used during the ASPT phase. The resulting data produced the following findings: (a) using IP ratings. no differences in simulator performance emerged between the Motion and No-Motion groups. (b) using the special data cards. no consistent differences emerged between the Motion and No-Motion groups. although several of the measures produced statistically significant effects. (c) significant learning occurred during

simulator training for both groups, (d) the two groups trained in the ASPT performed signficantly, although modestly, better in the T-37 than the control group; and (e) no significant differences emerged in T-37 performance between the Motion and No-Motion groups. This study indicates the need for developing better procedures for the training of aerobatic tasks in flight simulators. Although the data failed to reveal any significant or practical enhancement of training effectiveness as a result of the addition of platform motion, the modest degree of transfer makes the question of platform motion more academic than practical. (32 pp.)

58 Pohlmann, L.D., & Reed, J.C. Air-to-air combat skills: Contribution of platform motion to initial training. AFHRL-TR-78-53, AD-A062 738. Williams AFB, AZ: Flying Training Division, October 1978. Project 1123. NTIS. This study was conducted to assess the contribution of six-degrees-of-freedom platform motion to the training effectiveness of the Simulator for Air-to-Air Combat (SAAC) for training initial air-to-air combat skills. A transfer-of-training scheme was used. Two classes of Air Force pilots receiving initial training in the F-4 aircaft were divided into three groups. Two of the groups (eight pilots each) received training in Basic Fighter Maneuvers (BFM) using the SAAC, one group using platform motion and the other group not using platform motion. The remaining group (six pilots) did not receive SAAC training. All three groups followed the same syllabus in the aircraft.

Instructor pilot ratings of student performance on BFM tasks in the simulator and in four aircraft sorties for each student were collected. Analyses of Variance (ANOVAs) of ratings in the simulator were used to assess initial differences and learning effects in the simulator. ANOVAs of ratings in the aircraft were used to assess transfer of training effects.

Although learning effects in both simulator and aircraft were noted, the data did not show a transfer of training effect. For the tasks investigated, SAAC trained students did not perform better than those who did not receive SAAC training. Performance differences between the Motion and No-Motion groups were negligible. Potential reasons for this non-effectiveness, and possible simulator and training program modifications for improving this training effectiveness, are discussed. (26 pp.)

59 Swink, J.R., Butler, E.A., Lankford, H.E., Miller, R.M., Watkins, H., & Waag, W.L. Definition of requirements for a performance measurement system for C-5 aircrew members. AFHRL-TR-78-54, AD-A063 282. Williams AFB, AZ: Flying Training Division, October 1978. Project 1123, Contract F33615-76-C-0056, Logicon, Incorporated. NTIS. This study identified and defined C-5 aircrew tasks and performances essential to the effective operation of the aircraft on a typical, representative mission. It described present capabilities of C-5 simulators to determine how these capabilities might be implemented or augmented for measuring crew performance. The results of the above efforts were synthesized into a description of the requirements for a C-5 aircrew performance measurement subsystem. The study also identified the applicability of these C-5 simulator performance measures to the airborne environment. The capabilities of the C-5 aircraft systems to provide necessary data are described, and the results are synthesized into a functional description for a C-5 inflight performance measurement system. (76 pp.)

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60 Miller, R.H. Advanced Simulator for Pilot Training (ASPT): Refinement of environmental data base generation system. AFHRL-TR-78-55, AD-A059 857. Williams AFB, AZ: Flying Training Division, September 1978. Project 1192, Contract F33615-78-C-0001, Systems Engineering Laboratory. NTIS. This report documents the current status of the Advanced Simulator for Pilot Training visual data base generation system and the improvements of the software that have been made since delivery of the system. (44 pp.)

61 AFHRL-TR-78-56 (This number was not assigned to a report.)

62 AFHRL-TR-78-57 (This number was not assigned to a report.)

63 Czuchry, A.J., Doyle, K.M., Frueh, J.T., Baran, H.A., & Dieterly, D.L. Digital Avionics Information System (DAIS): Training Requirements Analysis Model (TRAMOD). AFHRL-TR-78-58(I), AD-A068 474. Wright-Patterson AFB, OH: Advanced Systems Division, April 1979. Project 2051, Contract F33615-75-C-5218, Dynamics Research Corporation. NTIS. The training requirements analysis model (TRAMOD) described in this report represents an important portion of the larger effort called the Digital Avionics Information System (DAIS) Life Cycle Cost (LCC) Study. TRAMOD is the second of three models that comprise a LCC impact modeling system for use in the early stages of system development. As part of the overall modeling system, the training model is an efficient tool for developing training programs on the basis of task, time, and resource criteria. This report explains the approach used in developing this model and its analytic value as a method for determining training requirements. Also, the methodology used to develop the task-related characteristic data necessary for its application to the DAIS are addressed. The model is described by explaining the techniques and algorithms used to accomplish its functic

The interactive nature of TRAMOD affords the user great flexibility in structuring its operation while retaining the capability of addressing specific training problems in depth. This report explains the basis for available options. The Users Guide, Volume II, presents these options and illustrates the manner in which user/model interaction is accomplished. (68 pp.)

64 Czuchry, A.J., Doyle, K.M., Frueh, J.T., Baran, H.A., & Dieterly, D.L. Digital Avionics Information System (DAIS): Training requirements analysis model users guide. AFHRL-TR-78-58(II), AD-A061 389. Wright-Patterson AFB, OH: Advanced Systems Division, September 1978. Project 2051, Contract F33615-75-C-5218, Dynamics Research Corporation. NTIS. The training requirements analysis model (TRAMOD) described in this user's guide represents an important portion of the larger effort called the Digital Avionics Information System (DAIS) Life Cycle Cost (LCC) Study. TRAMOD is the second of three models that comprise a LCC modeling system for use in the early stages of system development. As part of the overall modeling system, the training model is an efficient tool for developing training programs on the basis of task, time, and resource criteria. A date base containing information associated with these criteria is also included. The interactive nature of TRAMOD affords the user great flexibility in structuring its operation while retaining the capability of addressing specific training problems in depth. This guide explains the available options and illustrates the manner in which user/model interaction is accomplished. (80 pp.)

65   Miller, R.M., Swink, J.R., & McKenzie, J.F., Jr. Instructional Systems Development (ISD) in Air
      Force flying training. AFHRL-TR-78-59, AD-A064 689. Williams AFB, AZ: Flying Training
      Division, December 1978. Project 1123, Contract F33615-77-C-0034, Logicon, Incorporated.
      NTIS. This is the final report of a study which identified and defined problems associated with
      the application of ISD technology to Air Force flying training programs. Data for the study
      were collected by a structured interview technique and were categorized into 14 information
      categories. Analysis reduced the information to five problem identification/definition
      categories which are included as the main body of the report. Impact on ISD of each of the
      problems identified/defined is discussed. (68 pp.)

66   Gould, R.B. Air Force occupational attitude inventory development. AFHRL-TR-78-60, AD-
      A062 987. Brooks AFB, TX: Occupation and Manpower Research Division, October 1978.
      Project 7734. NTIS. This report describes the development of the operational version of the Air
      Force Occupational Attitude Inventory (OAI). The original OAI of 55 life history, 11 work
      history, and 348 specific job attitude statements was administered to 3,100 airmen to validate
      the 35 hypothesized job attitude dimensions used in development of the OAI and reduce the
      inventory to a minimum subset of items capturing the domain of job attitude variance
      measured by the full set of 348 items. Principal components factor analysis and varimax
      rotation resulted in identification of 35 job attitude facets which were markedly different from
      the hypothesized facets and from job satisfaction factors traditionally found in civilian
      literature. Because of skewed rectangular response distributions, the 8-point scale was revised
      to add a neutral point. The inventory was reduced to 200 attitudinal items using a computing
      algorithm titled VARSEL and then readminstered to a 10,000-case sample. Items were
      refactored and original empirical factors were validated, resulting in a conclusion that civilian
      and military personnel have different perspectives of their work environment and thus
      established that civilian job satisfaction inventories have limited utility in the military setting.
      (94 pp.)

67   Edwards, J.O., Jr. Comparative analyses of enlisted job satisfaction as measured by the
      occupational attitude inventory. AFHRL-TR-78-61, AD-A063 642. Brooks AFB, TX: Occupation
      and Manpower Research Division, October 1978. Project 7734. NTIS. This report describes
      the preliminary results of administering the Occupational Attitude Inventory (OAI) to 7,567
      airmen worldwide. Two-thirds of those sampled were first-term airmen. Results of the survey
      revealed numerous differences and similarities between first-termers and careerists.
      Differences and similarities were noted on background information items, job aspect items, job
      factors, and importance of job factors to career decisions. Job2Oactors with the highest job
      satisfaction ratings were opportunities for social contact, job security, moral acceptability of
      job, leave and time-off policies, supervisory responsibilities, safety programs, and family
      attitude toward job. Factors receiving low satisfaction ratings were cost of living, status in
      civilian community, promotion chances based on ability, and quality of base housing and
      eating facilities. There was considerable agreement between first-termers and careerists on
      which factors are the most dissatisfying, differences existing in intensity of feeling rather than
      direction. Factors that rated high in importance to career decisions included such job aspects as
      work itself, promotion chances, economic security, and self-improvement opportunities. Of the
      12 factors with high importance ratings only two were low in satisfaction ratings: promotion
      chances based on ability and cost of living. (102 pp.)

68 Alley. W.E. Vocational Interest-Career Examination: Use and application in counseling and job placement. AFHRL-TR-78-62, AD-A063 657. Brooks AFB, TX: Personnel Research Division, October 1978. Project 7719. NTIS. This report describes scales and supporting empirical documentation associated with the Vocational Interest-Career Examination (VOICE). The instrument provides a reliable quantitative basis for describing the vocational interests of people who may have little or no experience on the job and for relating this information to the appropriate choice of an occupational area. Basic interest and occupational scales are defined in terms of their relevant psychometric properties and potential applications in vocational counseling and job placement. Studies bearing on the reliability and validity of the scales for purposes of estimating future job satisfaction are summarized to provide users of the instrument with appropriate source material. (56 pp.)

69 Dansereau. D.F.. Collins. K.W.. McDonald. B.A.. Diekhoff. G.. Garland. J.C.. Holley, C.S.. Evans. S.H., Irons, D., Long, G.. Walker, C.. Hilton, T.. Lehman. D., Halemanu, M., Ellis, A.M., & Fenker, R.M. Systematic training program for enhancing learning strategies and skills: Further development. AFHRL-TR-78-63, AD-A061 014. Lowry AFB, CO: Technical Training Division, September 1978. Project 1121, Contract MDA-903-76-C-0218. Texas Christian University. NTIS. The purpose of the current research effort was to identify and validate the effectiveness of alternative learning strategies. Learners employing networking and interactive peer study substrategies achieved more than did no treatment controls. Similarly, strategies trained learners reported greater positive learning attitude changes than did controls. Although strategy components were perceived favorably by learners, the executive strategy (MURDER). networking. peer learning and concentration management strategies were the most highly rated. (62 pp.)

70 Dansereau. D.F.. Collins. K.W.. McDonald. B.A.. Garland. J.C.. Holley. C.S., Evans. S.H.. & Diekhoff. G.M. Learning strategy training materials: A selected subset. AFHRL-TR-78-64, AD-A062 739. Lowry AFB. CO: Technical Training Division, September 1978. Project 1121, Contract MDA-903-76-C-0218. Texas Christian University. NTIS. Materials contained within this report are designed to assist learners in the acquisition and subsequent practice of primary and support learning strategies. Primary strategy materials are grouped into (1) comprehension and retention and (2) retrieval and utilization. Support strategy materials include (1) goal setting. (2) concentration management. and (3) information monitoring-feedback. The current practice materials and methods are an outgrowth of experimental approaches to the design, development and validation of a learning strategies training program. Some of the strategies have been shown to increase learner achievement as much as 43% over control groups. (172 pp.)

71 Bergmann. J.A. Occupational analysis of the civilian WG-6900 warehousing family. AFHRL-TR-78-65, AD-A073 418. Brooks AFB. TX: Occupation and Manpower Research Division, November 1978. Project 7734. NTIS. This is one of a series of reports concerning Air Force civilian employees. and marks the initial application of job survey methodology to the Wage Grade (WG) area. Data from 4,036 subjects were analyzed by use of the Comprehensive Occupational Data Analysis Program (CODAP). Comparative evaluations of job content for eight job series by Base and Air Logistics Center (ALC) supply system were performed. and job types were identified based on a cluster analysis. The report presents results of these analyses. evaluates the procedures employed in the study. and makes recommendations for future applications of this technology to the civilian workforce. (108 pp.)

72   Black, D.E. Mathematical and statistical software index. AFHRL-TR-78-66, AD-A062 991. Brooks AFB, TX: Computational Sciences Division, November 1978. Project 6323. NTIS. This report is an abridged documentation source for the Air Force Human Resources Laboratory (AFHRL) mathematical and statistical softwa... library for use by Air Force personnel researchers. It provides a single reference which researchers may quickly scan to identify mathematical or statistical computer software which is currently operational on the AFHRL Univac 1108 computer system and which is available to them for use in their research projects. The report is comprised of four chapters with the first chapter devoted to introductory information: the second chapter, to descriptions of 27 computer programs: the third chapter, to descriptions of the library's subroutine systems: and the final chapter, to the nationally recognized statistical packages available in the software library. (94 pp.)

73   Kantor, J.E., Noble, B.E., Leisey, S.A., & McFarlane, T.A. Air Force female pilots program: Initial performance and attitudes. AFHRL-TR-78-67, AD-A065 641. Brooks AFB, TX: Personnel Research Division, February 1979. Project 7719. NTIS. Following the 1975 decision to open Air Force pilot training to qualified officers of both sexes, research was undertaken (a) to establish a data base, from female pilot selectees, composed of pre-training measures found to be predictive of training performance for men, (b) to compare these data with those previously obtained from male pilot selectees for overall performance and predictive efficiency, and (c) to monitor the flying performance of women as judged by themselves, their instructors, and their supervisors in comparison with official Air Force flight standards and relative male performance. It should be noted that the results, presently available, are preliminary and reflect only the initial summary of findings from a continuing research project.

Few signficant differences were found between men and women entering pilot training. Comparable performance on most pre-training measures, combined with equivalent graduation rates, factors associated with flight training performance, and student impressions of the flight training experience, all lend strong support to the conclusion that men and women behave similarly in flight training. However, instructor ratings of male and female student characteristics did reveal several areas in which males were rated significantly better. The factors underlying these differential ratings were not discernible from the available data. Overall, the similarities between the sexes greatly outweighted the differences, indicating that coeducational pilot training can be accomplished without significant modification to the training system or resultant change in student attrition rate. (40 pp.)

74   Ree, M.J. Estimating item characteristic curves. AFHRL-TR-78-68, AD-A064 739. Brooks AFB, TX: Personnel Research Division, November 1978. Project 7719. NTIS. A simulation study of the effectiveness of the following four item characteristic curve estimation programs was conducted: ANCILLES, OGIVIA (from U. S. Civil Service Commission): LOGIST (from Educational Testing Service): and simple transformations to the item-test biserial correlation. Using the three-parameter logistic model, three groups of 2,000 simulated subjects were administered 80-item tests. These simulated item responses were then calibrated using the four programs. The estimated item parameters were compared to the known item parameters in four analyses for each program in all of the three data sets. It was concluded that the selection of an item calibration procedure should be dependent on the distribution of ability in the calibration sample, the planned uses of the item parameters, and the computer resources available. (18 pp.)

75 Massey, R.H., Mullins, C.J., & Earles, J.A. Performance appraisal ratings: The content issue. AFHRL-TR-78-69, AD-A064 690. Brooks AFB, TX: Personnel Research Division, December 1978. Project 2313. NTIS. Three kinds of rating statements, trait-oriented, worker-oriented, and task-oriented, were evaluated in a context permitting the comparisons to be made in terms of criteria external to the ratings. One hundred twenty Air Force noncommissioned officers assigned to seminar groups of 13 or 14 at the Air Training Command NCO Academy, Lackland AFB Annex, were involved in this experiment.

No evidence of superiority was found for any of the three sets although significant correlations with various external criteria were obtained in all three experimental conditions. Significant differences were also found among the three rating sub-groups comprising each of the three treatment groups although these rating sub-groups were assigned randomly to the three treatment groups. The importance of controlling for group effects in peer group studies was noted. (20 pp.)

76 Mullins, C.J., Weeks, J.L., & Wilbourn, J.M. Ipsative rankings as an indicator of job-worker match. AFHRL-TR-78-70, AD-A065 053. Brooks AFB, TX: Personnel Research Division, December 1978. Project 2313. NTIS. Ipsative measures of rated characteristics avoid the problems of halo and leniency error, but they have not been useful in discriminating between subjects (normative uses). This study investigated the efficacy of converting ipsative measures of subjects and of jobs to a job-worker match coefficient of correlation, which then might be used normatively. The results did not firmly establish the superiority of either ipsative or normative rankings. (20 pp.)

77 Siegel, A.I., Musetti, L.L., Federman, P.J., Pfeiffer, M.G., Wiesen, J.P., DeLeo, P.J., & Shepperd, W.R. Criterion referenced testing: Review, evaluation, and extension. AFHRL-TR-78-71, AD-A074 539. Lowry AFB, CO: Technical Training Division, August 1979. Project 2313, Contract F33615-77-C-0046, Applied Psychological Services, Incorporated. NTIS. The literature relative to criterion referenced test development is reviewed. Rater error in criterion referenced performance evaluation is discussed, and a statistical model for reducing such bias in Air Force applications is presented and experimentally evaluated. The results suggest the utility and applicability of the method in Air Force applications. Needed research into criterion referenced testing in the Air Force is described. The results of a field study into criterion referenced testing in Air Force technical training courses are presented and the implications of the results for Air Force technical training are given. (122 pp.)

78 McDonald, M.J., Smith, B.A., Evans, D.W., Baer, L.H., & Nelson, W.H. F-15 flight simulator: Development and analysis of computer scoring algorithm. AFHRL-TR-78-72, AD-A067 765. Williams AFB, AZ: Flying Training Division, March 1979. Project 1123. NTIS. This study was designed to develop and evaluate the computer scoring algorithm of the F-15 flight simulator. Subjects were F-15 pilots in the grade of 1st Lt through Lt Col with previous flying experience commensurate with grade and operational assignments. Evaluation involved simultaneous scoring by the computer and Instructor Pilots (IP) of flight departures and approaches. Both scores were then compared to estimate the validity of the computer algorithm. Departure scores were moderately correlated ($r = .75$); however, approach scores exhibited moderate to high negative correlation ($r = .01$ to $-.91$). Interaction from the IPs indicated that scoring parameters measured by the computer were correct. It was determined that the negative correlations on the approaches were a result of the computer initiating scoring whenever a certain range boundary was reached, whereas the IPs began scoring only when the appropriate

legs of the approaches were being flown. This variance is being investigated and a modification has been recommended. Because of the correlation of the departure scores, it was concluded that with improvements to the computer scoring procedures for the approaches, the scoring algorithms of the F-15 flight simulator could provide a valuable tool for evaluation of fighter pilots. (30 pp.)

79　Albery, W.B., Gum, D.R., & Kron, G.J. Motion and force cueing requirements and techniques for advanced tactical aircraft simulation. AFHRL-TR-78-73, AD-A064 691. Wright-Patterson AFB, OH: Advanced Systems Division, December 1978. Projects 6114 and 1958. NTIS. The Air Force Human Resources Laboratory (AFHRL) has the responsibility for research and development of advanced simulation techniques, including motion and force cueing requirements and techniques. This report is a summary of the efforts currently underway at AFHRL under Projects 6114 and 1958 which are directed at advanced tactical aircraft simulation. The approach being pursued is two-fold: the first part includes efforts directed towards building a data base for use in developing cueing requirements; the second part includes efforts to improve the performance of existing devices that have been shown to be somewhat effective and to develop new devices and techniques as indicated by the data base efforts. Exploratory efforts including the development of a composite sensory model, the design of high-g augmentation devices. the development of a myoelectric feedback display dimming technique and the collection of g-cue environment data are discussed. An advanced development effort. the advanced g-cueing system (including g-seat, g-suit, and seat shaker), is highlighted. (20 pp.)

80　Leisey, S.A., & Vitola, B.M. Characteristics of Air Force accessions: January 1975 to June 1977. AFHRL-TR-78-74, AD-A066 659. Brooks AFB, TX: Personnel Research Division. January 1979. Project DALS. NTIS. Analyses of the January 1975 through June 1977 accessions resulted in the following conclusions. (a) The Air Force continues to be an equal opportunity employer, enlisting Blacks at a proportion comparable to the percentage they represent in the population-at-large. (b) Regardless of sex or racial/ethnic group, the majority of Air Force enlistees are 17 to 20 years old and offer relatively less skill to the labor market and experience a high unemployment rate than do older, more experienced workers. (c) The aptitude potential of men and women has risen consistently from 1975 to 1977, and there has been an increase in the numbers of men and women who qualify for possible career fields at the upper aptitude index levels. (d) Educational levels indicate a moderate gain in the percentage of accessions having completed at least a high school education. (e) Men and women from US Enlistment Regions 4 and 5 (Middle and Far West) demonstrate higher Mechanical and Electronics aptitudes, and those from Region 1 (Northeast) generally show higher General and Administrative aptitudes. (30 pp.)

81　Reed, J.A., & Reed, J.C. Air refueling director lights trainer: Analysis and evaluation of training effectiveness. AFHRL-TR-78-75, AD-A066 660. Williams AFB, AZ: Flying Training Division. January 1979. Project 1123. NTIS. The objectives of this study were to (a) determine whether the pilot students could meet the Criterion Referenced Objectives, (b) evaluate the relative contribution of director lights training to pilot performance, and (c) analyze the configuration of the trainer as a prototype for subsequent models. These objectives were accomplished with 21 pilot students in the Air Refueling (AR) Phase of F-4C training at Luke AFB, Arizona. All pilots received normal syllabus training prior to the AR Phase. A Control Group (n = 10)

continued with normal syllabus training, while the Experimental Group (n =11) received a 1 hour block of training on the Air Refueling Director Lights Trainer. Both groups of students then flew six air refueling missions in the aircraft: four were day and two were night missions. Analysis of the results indicated that the trainer did contribute to learning, hence performance, in the aircraft. It was also found that the pilot students continued to improve throughout all missions in the AR Phase. (30 pp.)

82 Hahn, C.P. Field evaluation system for Air Force technical training: Analysis and modification. AFHRL-TR-78-76, AD-A066 920. Lowry AFB, CO: Technical Training Division, February 1979. Project 1121, Contract F33615-77-C-0039, American Institutes for Research. NTIS. In the present study an analysis was performed of the Air Training Command's (ATC) field evaluation program. Data obtained from this program are used to provide feedback to the instructional system regarding how well graduates of resident courses perform in the field subsequent to graduation. Shortcomings in the present system were identified through extensive and comprehensive group interview methods. New methods of data collection and analysis were devised to increase the usability of the information gathered by ATC evaluation divisions. These methods were demonstrated in a routine evaluation of the Aircraft Electrical Systems Specialist Course, an apprentice level course taught at Chanute AFB. The demonstration was judged to be successful, and the report illustrates alternative methods of tabulating and interpreting data. It was recommended that these results be reviewed by ATC officials prior to system-wide modifications. (153 pp.)

83 Fink, C.D., & Shriver, E.L. Maintenance training simulators at Air Force technical training centers: Present and potential use. AFHRL-TR-78-77, AD-A064 692. Lowry AFB, CO: Technical Training Division, December 1978. Project 2361, Contract F33615-77-C-0051, Kinton, Incorporated. NTIS. The objective of this study was to identify the present and potential need for maintenance training simulators in support of Air Force technical training and to assess the usefulness of instructor surveys in identifying the need for simulation. Data were collected through the use of survey questionnaires and instructor interviews. Results indicated a willingness on the part of most instructors to use low cost/fidelity simulators as supplementary training devices but not as replacements for actual equipment trainers. In addition, a simulative potential ranking formula was employed which resulted in the identification of 36 high priority candidates for simulation. Thirty-two of the 36 candidates represented electronic equipment, particular test benches. The validity of the data collected using the questionnaire methodology is discussed along with the problems inherent in using instructors to identify solutions for training problems. It was concluded that the survey procedure was useful for identifying simulation candidates but that final decisions on simulator usage should be left to simulation experts. Recommendations are provided for modifying the questionnaire formats and further study of the simulation candidates identified in this study. (134 pp.)

84 Edwards, B.J., Weyer, D.C., & Smith, B.A. Undergraduate pilot training: Visual discrimination pretraining for landing task. AFHRL-TR-78-78, AD-A068 141. Williams AFB, AZ: Flying Training Division, February 1979. Project 1123. NTIS. The utility of training task-relevant visual discrimination skills as prerequisite behaviors for subsequently taught landing skills was investigated in this study. A multi-media training package was developed and used to impart visual skills to student pilots prior to their training on the flightline in landing procedures in

the T-37 aircraft. The transfer of the visual discrimination skills of the landing field environment was assessed by measuring students' landing skills in the Advanced Simulator for Pilot Training and in the T-37 aircraft. Results showed that pretrained and non-pretrained student group performances on most measures were not significantly different. In several specific parameters of performance, non-pretrained groups performed significantly better in the aircraft transfer tests as rated by instructor pilots. (40 pp.)

85 Headquarters Air Force Human Resources Laboratory. Fiscal Year 1980—Air Force technical objective document. AFHRL-TR-78-79, AD-A064 355. Brooks AFB, TX: Headquarters Air Force Human Resources Laboratory, November 1978. (Covers all AFHRL projects). NTIS. This document provides the academic and industrial R & D community with a summary of the technical area objectives of Air Force research in the field of human resources. The areas covered are: (a) Personnel and Manpower Management. (b) Education and Training. (c) Personnel Selection and Retention. (d) Force Structure and Utilization. (e) Flying Training Technology. (f) Technical Training Technology. (g) Simulation Technology for Training, and (h) Personnel and Training Factors in Advanced Systems. (18 pp.)

86 AFHRL-TR-78-80 (This number was not assigned to a report.)

87 Bunker, W.M., & Pester, R.F. Computer Image Generation: Improved edge utilization study. AFHRL-TR-78-81, AD-A065 640. Wright-Patterson AFB, OH: Advanced Systems Division, February 1979. Project 6114. Contract F33615-77-C-0033, General Electric Company. NTIS. Computer Image Generation (CIG) systems for visual scene simulation are now being procured for research and as pilot training simulators. Any given system has limited edge capacity, so it is important that the edges be utilized effectively to provide the simulated visual scene for training. The level-of-detail concept in current CIG systems improves efficiency of edge utilization.

A feature at such a distance that it has a small view window image is computed at a low level of detail using few edges. As the viewer approaches the feature, and its image becomes larger, a model containing more detail and more edges is computed to represent it. The high sensitivity of the eye to abrupt changes makes the transition distracting and limits the usefulness of this technique. This study developed techniques to produce a gradual transition from one detail to the other. Evaluation scenes and sequences demonstrated this to be far less obvious and distracting. Another area of investigation provided high detail in the portion of the view window to which the view is directed (the "area of interest") with gradual transition to low detail elsewhere. (76 pp.)

88 Mathews, J.J., Valentine, L.D., Jr., & Sellman, W.S. Prediction of reading grade levels of service applicants from Armed Services Vocational Aptitude Battery (ASVAB). AFHRL-TR-78-82, AD-A063 656. Brooks AFB, TX: Personnel Research Division, December 1978. Project 7719. NTIS. The objectives of this study were to assess reading ability of military service applicants and accessions and to determine the relationship between ASVAB measures and reading scores. Data were collected at Armed Forces Examining and Entrance Stations. This report concerns 2,432 subjects given the Gates-MacGinitie reading test and a subsample given

the Nelson-Denny reading test. The median reading grade level for service applicants was 9.0 based on Gates-MacGinitie and 9.5 based on Nelson-Denny. The median Gates-MacGinitie reading grade level of applicants who qualified for services was 10.2 compared to 5.7 for non-qualified applicants. The Armed Forces Qualification Test correlated .76 with the average of reading grade levels for the two reading tests. The ASVAB General Technical (GT) composite (General Aptitude Index (AI) for Air Force) correlated .79 with average reading grade level. It was recommended that GT be used as an index of reading grade level for service applicants. (16 pp.)

89 Borah, J., Young, L.R., & Curry, R.E. Sensory mechanism modeling — final report. AFHRL-TR-78-83, AD-A069 439. Wright-Patterson AFB, OH: Advanced Systems Division, February 1979. Project 6114, Contract F33615-76-C-0039, Gulf + Western Applied Science Laboratories. NTIS. Pilots use information from a variety of sensory mechanisms to determine their estimate of orientation and motion. An understanding of this process and a quantitative model are essential for development of effective simulator motion cueing devices. A multisensory model for dynamic spatial orientation is being developed for this purpose. Aircraft or simulator motion is translated into stimuli which are processed by dynamic models of the appropriate sensors (visual, vestibular, tactile, and proprioceptive), and are then fed to a central estimator which has been modeled as a linear optimal estimator, specifically a steady state Kalman Filter. In addition to the linear estimation process, some non-linear effects, such as the well documented delay in onset of visually induced motion, require non-linear additions to the model. Such additions have been kept to a minimum so as to retain the uniqueness and conceptual appeal of a linear optimization algorithm.

The model has been implemented as a computer program and has predicted some of the important qualitative characteristics of human dynamic spatial orientation under combined wide field visual motion and platform motion. Several types of special tactile and proprioceptive cues are also being considered but have not been validated.

The modeling effort has underscored the need for additional data in some areas and several experiments have been suggested to help fill these gaps. (88 pp.)

90 Dempsey, J.R., Sellman, W.S., & Fast, J.C. Generalized approach for predicting a dichotomous criterion. AFHRL-TR-78-84, AD-A066 661. Brooks AFB, TX: Occupation and Manpower Research Division, February 1979. Project 2077. NTIS. This report refines and improves upon a conceptual model and a mathematical procedure, based upon a blend of Likelihood Function Estimation (LIFE) and utility theory. Empirical studies conducted by the Air Force Military Personnel Center in 1975 and 1976 have shown that the LIFE procedure can be very useful in the prediction and study of dichotomous behavior, e.g., predicting attrition/success of a trainee in an Air Force Training program. The technique has been previously used to study attrition from the United States Air Force Academy and Basic Military training. By generalizing the LIFE technique it can be applied to the situation of studying and predicting any dichotomous dependent variable. Currently, the Air Force Human Resources Laboratory is continuing studies of the procedure to compare its usefulness to other mathematical methods. (22 pp.)

91 Mullins, C.J., & Winn, W.R. Criterion development for job performance evaluation: Proceedings from symposium 23 and 24 June 1977. AFHRL-TR-78-85, AD-A066 885. Brooks AFB, TX: Personnel Research Division, February 1979. Project 2313. NTIS. This report consists of the proceedings from a symposium conducted 23 and 24 June 1977 in San Antonio, Texas. The purpose was to bring together several of the researchers who have been recently concerned with various aspects of criterion research to exchange ideas over a 2-day period, and to provide discussion and critique of the directions our respective research efforts are taking. More formal presentations of work and ideas connected with criterion research by military scientists comprised the central part of the 2-day period. It was preceded by more informal material in the way of introductory remarks, and it was followed by summary material provided by a panel of five eminent researchers from the civilian community who were invited to serve as expert consultants and to give us their views concerning our work. The informal materials preceding and following the formal presentations were taken directly from tape recordings of the proceedings, and, with minor editorial changes by the speakers (who were invited to review their remarks prior to publication) appear just as they were spoken. (192 pp.)

92 Zimmerlin, T.A., Sutty, G.J., & Stenger, A.J. Data base descriptors for electro-optical sensor simulation. AFHRL-TR-78-86, AD-A065 043. Wright-Patterson AFB, OH: Advanced Systems Division, February 1979. Project 6114, Contract F33615-77-C-0049, Technology Service Corporation. NTIS. The purpose of this study is to investigate the use of the Defense Mapping Agency Aerospace Center (DMAAC) digital source data for simulation of Forward Looking Infrared (FLIR) and Low Light Level Television (LLLTV) sensor imagery during various periods of the day and seasons of the year. This includes determination of deficiencies of the DMAAC data base which limit its use as well as identification of additional parameters which would increase its utility for sensor simulation.

The approach taken in the study was to determine what information is required of the scene, its environment, and the sensor and to generate realistic imagery from it. Then imagery using lesser amounts of data can be generated for various user applications. The impact on the data base can then be assessed for a given application and level of detail in the imagery.

The results of this study include a realistic tonal model for the simulation of passive sensor imagery of complex cultural scenes, the generation of imagery from a scene constructed according to the DMAAC specifications, an assessment of the resultant diurnal and seasonal imagery, and the relationship between the model data requirements and the resources of the data base. (76 pp.)

93 Baum, D.R., Clark, C., Coleman, T.P., Lorence, S., Persons, W., & Miller, G.G. Maintenance training system: 6883 converter/flight control test station. AFHRL-TR-78-87, AD-A066 669. Lowry AFB, CO: Technical Training Division, January 1979. Project 2361, Contract F33615-76-C-0054, Honeywell Systems and Research Center. NTIS. The Technical Training Division of the Air Force Human Resources Laboratory is investigating the application of simulation technology to maintenance training. The primary objectives of the project entitled "6883 Converter/Flight Control Test Station Maintenance Training System (MTS)" were (a) design, build, test, and install a prototype, simulator-based system to train test station operators and maintainers, and (b) provide the Air Force with a research tool for evaluating the practicality, cost- and training-effectiveness of simulated equipment for intermediate-level maintenance training. This report describes the design features and operation of the system. The 6883 MTS should provide much needed simulator effectiveness data. The technical achievements of the program are applicable to the procurement of future simulation-based training systems. (94 pp.)

94 Eisele, C.R., Bell, T.R., & Laidlaw, C.D. Cost analysis of Air Force on-the-job training: Development and demonstration of a methodology. AFHRL-TR-78-88, AD-A069 791. Lowry AFB, CO: Technical Training Division, May 1979. Project ILIR, Contract F33615-76-C-0063, CONSAD Research Corporation. NTIS. The Air Force on-the-job training (OJT) cost estima ing methodology documented in this report is applicable to formal airman upgrade training to the 3, 5, and 7 skill levels. The methodology can be used to provide reasonable cost estimate for budgeting and planning purposes at various command levels and for various time intervals Design of the methodology has emphasized use of existing data bases to derive direct OJT costs. Cost elements which have been quantified include program overhead costs at all command levels, personnel time cost for actual training and supervision, and program support costs such as for career development courses and the Extension Course Institute. Recommendations have been made concerning equipment and opportunity costs. The methodology employs additive cost factors which are sensitive to OJT cost variation among career fields and among organizations at each command level. Periodic factor reestimation will insure cost factor currency allowing OJT cost forecasts driven by forecasted OJT trainee-month volumes. (230 pp.)

95 Mullins, C.J., Seidling, K., Wilbourn, J.M., & Earles, J.A. Rater accuracy study. AFHRL-TR-78-89, AD-A066 779. Brooks AFB, TX: Personnel Research Division, February 1979. Project 2313. NTIS. Eight hundred eighty-two airmen were divided into more accurate and less accurate rating groups on the basis of their ability to estimate scores of their peers on a vocabulary test. To test whether the method actually did separate more accurate from less accurate raters, correlations were calculated within the more and less accurate groups between ratings of carefulness and scores on carefulness tests and between ratings of decisiveness and scores on decisiveness tests. The analysis consisted of counting the number of times the correlations between test scores and ratings in the more accurate group were larger than the analogous correlations in the less accurate group and computing the probability that this number of differences in the predicted direction might be expected by chance. It appears that this method of identifying accurate raters does work reasonably well. Several auxiliary questions concerning the best qualities to test in the estimating part of the study and the generalizability of rater accuracy to different personality characteristics were asked and answered. (18 pp.)

96 Ragan, T.J., Back, K.T., Stansell, V., Ausburn, L.J., Ausburn, F.B., Butler, P.A., Huckabay, K., & Burkett, J.R. Cognitive styles: A review of the literature. AFHRL-TR-78-90(I), AD-A069 435. Lowry AFB, CO: Technical Training Division, May 1979. Project 2313, Contract F33615-77-C-0047, University of Oklahoma. NTIS. A review of the literature to identify the various cognitive style constructs and the instruments used to measure them was completed. Each was evaluated with specific attention to possible relationships to Air Force technical training. Ten cognitive styles were selected for an in-depth summary of the state of the art, with special attention given to those that gave most promise for use. (62 pp.)

97 Back, K.T., Stansell, V., Ragan, T.J., Ausburn, L.J., Ausburn, F.B., & Huckabay, K. Cognitive styles: A bibliography and selected annotations. AFHRL-TR-78-90(II), AD-A069 457. Lowry AFB, CO: Technical Training Division, May 1979. Project 2313, Contract F33615-77-C-0047, University of Oklahoma. NTIS. The bibliography entries and annotations presented in this report are the result of an extensive review of research literature concerning cognitive style

constructs and their measuring instruments. Ten cognitive styles were identified as most relevant. This bibliography was the basis from which the review of the cognitive style literature (AFHRL-TR-78-90(I)) was written. (90 pp.)

98 Ausburn, L.J. Impact of learning styles on Air Force technical training: Relationships among cognitive style factors and perceptual types. AFHRL-TR-78-91(I), AD-A069 443. Lowry AFB, CO: Technical Training Division, May 1979. Project 2313, Contract F33615-77-C-0047, University of Oklahoma. NTIS. The purpose of the study was to investigate simultaneously the four cognitive styles, field dependence-independence, reflectivity-impulsivity, leveling-sharpening, and visual-haptics. Results indicated that although the constructs overlapped somewhat, each cognitive style has enough unique characteristics that each must be considered individually. When using cognitive styles as a variable in future research with Air Force technical training, perhaps requirements of specific tasks involved in the training will dictate which cognitive style discussed in this preliminary investigation holds the most promise. (34 pp.)

99 Ausburn, F.B. Impact of learning styles on Air Force technical training: Multiple and linear imagery in the presentation of a comparative visual location task to visual and haptic subjects. AFHRL-TR-78-91(II), AD-A069 444. Lowry AFB, CO: Technical Training Division, May 1979. Project 2313, Contract F33615-77-C-0047, University of Oklahoma. NTIS. The purpose of this study was to develop instruction based on the supplantation theory, in which tasks are performed (supplanted) for individuals that are unable to perform them due to their cognitive style. Results of this study indicate that in the particular learning situation in this investigation, the haptic cognitive style individual's performance was improved by instruction based on the supplantation theory. The results of this preliminary investigation seem to hold promise for instructional research with Air Force technical training personnel. (32 pp.)

100 McGuire, D.C., & Lee, D.R. Advanced Simulator for Pilot Training (ASPT): G-seat optimization. AFHRL-TR-78-92, AD-A068 475. Williams AFB, AZ: Flying Training Division, February 1979. Project 1123. NTIS. This report documents Phase I (of III) of a project to optimize the effectiveness of the ASPT g-seat in terms of both hardware and software performance. The transport lag was reduced to 20 ms by moving the Conoflow valves to the platform and using higher diameter hoses. The time constant was reduced to 150 ms by using larger diameter hoses, changing the needle valve location, and optimizing the settings of the booster and needle valve adjustments. The software has been reorganized, improved, streamlined and documented so that it may be more readily used to determine the most effective drive techniques. The optimized system will be used in a Phase II to determine the most effective drive technique and in a Phase III which will emulate new g-cueing devices, geometries, and drive schemes. (34 pp.)

101 Hendrix, W.H., & Halverson, V.B. Organizational survey assessment package for Air Force organizations. AFHRL-TR-78-93, AD-A068 476. Brooks AFB, TX: Occupation and Manpower Research Division, February 1979. Project 2313. NTIS. Development of an Organizational Assessment Package (OAP) to support the Air Force Leadership and Management Development Center (LMDC) is presented. The model on which the OAP was developed is presented, followed by the development process and factors isolated. Relationships between background data and criteria are tabulated, and recommendations for an operational OAP and printout formats are outlined. (48 pp.)

102 Walsh, M.J., Burgin, G.H., & Fogel, L.J. Tactical performance characterization: Basic methodology. AFHRL-TR-78-94, AD-A069 297. Wright-Patterson AFB, OH: Advanced Systems Division, May 1979. Project 6114, Contract F33615-78-C-0011, Decision Science, Incorporated. NTIS. This effort is to develop new methods of characterizing important features of tactical performance for display at an instructor/operator station of a flight simulator. In particular, the work included developing a technique for computing the weight or importance that a pilot assigns to various performance criteria. The work documented here represents the first of a two-phase program. Phase 1 involved developing the basic techniques and methods without collecting extensive pilot data. Phase 2 involves applying the methods to real pilot data collected on the Simulator for Air-to-Air Combat.

The approach was based upon a previously developed Adaptive Maneuvering Logic (AML) program. This program operates one-on-one against a real opponent to provide practice in combat flying. It operates by computing a "score" for each of several alternative next-moves and then executing the move rated highest. The score consists of a sum of weights assigned to each of the various criteria that would be satisfied if the move in question were chosen. The weights are fixed in the AML program. Thus, the program uses a fixed set of weights to produce a simulated performance.

The approach in this effort was to allow these weights to vary in fitting the output of the AML to that of a given pilot. In this way, the values of the weights may infer the importance that the pilot attaches to the various criteria and give valuable insight to his internal objectives.

Phase 1 work included using one AML program to emulate the pilot and developing the methods to compute the weights using a second AML program. It was found that for most criteria, the solution was fairly accurate and improved as more and more data were collected and used. Once the general mechanics were finished, the criteria themselves were examined with the goal of substituting new criteria that would be more useful to an instructor pilot. This effort revealed that to be of maximum utility, the criteria need to be maneuver-specific and should relate to the various flight maneuvers used in training combat tactics. Since the AML program was not designed to fly these specific maneuvers, work was directed toward modifying the AML accordingly. The report concludes with descriptions of these modifications and the successful use of the AML in flying a high speed yo-yo (a combat maneuver). (78 pp.)

103 Krahenbuhl, G.S., Marett, J.R., & Reid, G.B. Stress and simulation in pilot training. AFHRL-TR-78-95, AD-A066 670. Williams AFB, AZ: Flying Training Division, February 1979. Project 2313, Contract F41609-75-C-0028, Arizona State University. NTIS. Catecholamine excretion for 20 USAF student pilots and 13 instructor pilots was determined during daily activities, during sorties performed in high realism simulators, and during actual flight. High realism simulation resulted in a measurable stress response in both students and instructors; the response was not related to previous flight experience. One group of students (experimental, n=10) experienced power-on stalls and spin recoveries in the simulator prior to their introduction in the aircraft. A second group of students (control, n=10) experienced power-on stalls and spin recoveries in the aircraft prior to their introduction in the simulator. Catecholamine excretion during simulation was not different for the two groups, thus aircraft exposure to the spin series did not alter the stress response of the students attempting a similar maneuver in a high realism simulator. Catecholamine excretion during the aircraft spin was also similar for the experimental and control groups; however, the relative proportions of epinephrine and norepinephrine were different for the experimental and control groups. Thus, task-specific high realism simulation introduced prior to exposure to related stressful in-flight tasks results

in similar total stress response, but somewhat lower arousal and greater mental activity. A comparison of superior and inferior students within each group suggested that the simulator pretraining had the greatest effect on the inferior students. A comparison of student and instructor catecholamine excretion from the aircraft power-on stall and spin recovery lesson unit showed a lack of significant relationship. There was, however, a significant negative relatioship between student performance and instructor stress during the initial aircraft power-on stall and spin recovery sortie. (26 pp.)

104 Hughes, R.G. Advanced training features: Bridging the gap between in-flight and simulator-based models of flying training. AFHRL-TR-78-96, AD-A068 142. Williams AFB, AZ: Flying Training Division, March 1979. Project 1123. NTIS. An overview of advanced training features in flying training simulation is presented as well as a conceptual framework for distinguishing between enabling and instructional features. Reported shortcomings in the training of simulator instructor/operator personnel are seen as resulting in part from the rapid transition from in-flight to simulator-based training and in part from the absence of a behavioral conceptualization of the flying task itself. It is suggested that the area in which the flight simulator may be most effectively exploited lies in its capability for allowing the instructor to alter the basic structure of the task itself for the purpose of applying recognized learning principles and methods. Data on the effective application of backward chaining to a 30° dive bombing task are presented. (20 pp.)

105 Looper, L.T. Career Area Rotation Model (CAROM): Historical overview of technique and utilization. AFHRL-TR-78-97, AD-A068 820. Brooks AFB, TX: Occupation and Manpower Research Division, April 1979. Project 2077. NTIS. This report provides a management overview of the Career Area Rotation Model (CAROM) and reviews the utilization of the model as an aid in the formulation of personnel policy.

The objectives of this study were twofold. First, a review of the development of CAROM was made along with an overview intended for personnel and manpower managers. The second purpose was to discuss how the model could be used in actual decision-making situations through the presentation of two previous applications. One application involved the analysis on the enlisted force in several career fields of alternative promotion systems. The other application was concerned with studying CONUS rotation base problems brought about by varying overseas tour lengths. In both applications, it was seen that CAROM provided considerable relevant information to the personnel policy decision process. (26 pp.)

106 Woodruff, R.R., Longridge, T.M., Jr., Irish, P.A., III, & Jeffreys, R.T. Pilot performance in simulated aerial refueling as a function of tanke: model complexity and visual display field-of-view. AFHRL-TR-78-98, AD-A070 231. Williams AFB, AZ: Flying Training Division, May 1979. Project 1123. NTIS. This research was conducted in the Advanced Simulator for Pilot Training (ASPT) to determine Computer Image Generation (CIG) complexity and field-of-view (FOV) requirements for aerial refueling (AR). The adequacy of three detail levels and five FOVs was assessed. Aircraft simulated, in addition to the KC-135 tanker, were the A-10, F-4, B-52, and F/FB-111. Twelve experienced pilots (three per aircraft) served as subjects. Performance measures included elapsed time to criterion, number of disconnects and aircraft control profile. An assessment of FOV position employed for takeoff/landing versus AR was also made. A-10 and F-4 pilots found the visual FOV position employed for simulated takeoff/landing must be raised approximately 12 degrees to accomplish AR. B-52 and F-111 pilots found AR could be

satisfactorily performed using the same FOV position employed for takeoff/landing. Performance measures clearly indicated that AR performance varies as a function of both FOV size and tanker detail level. The larger the FOV, the better the performance. Similarly, the more detailed the tanker model, the better the performance. (24 pp.)

107 Foley, J.P., Jr. Instructional materials for improved job performance. AFHRL-TR-78-99, AD-A064 363. Wright-Patterson AFB, OH: Advanced Systems Division, January 1979. Project 1710. NTIS. Research and Development supported by the various military services has produced several technologies for the development of improved instructional materials. This paper concerns the applicability of these technologies for the training of industrial and vocational education teachers. The paper emphasizes two general types of technologies, i.e., task oriented training (TOT) and improved task guidance and information (ITG& I). The most task oriented ITG& I are fully proceduralized job performance aids (FPJPA)—a characteristic which facilitates tradeoff between FPJPA and TOT sometimes called the "head"/book tradeoff. The key characteristics and requirements of the FPJPA technology are briefly described and include a formal task identification and analysis (TI& A) of each identified task, standard language and keyed pictorials for maintenance instructions, appropriate format for the maintenance environment, and "hands on" verification of the effectiveness of each FPJPA product utilizing subjects from the target user population. The task identification process is common to both TOT and FPJPA, and the analysis process should control the content of TOT, FPJPA, and TOT/FPJPA tradeoff. Samples of ITG& I, including FPJPA, are displayed but the reader is cautioned that content of instructional materials placed in this format must be controlled by the developmental process. The paper also briefly describes some industrial applications of the ITG& I and TOT technologies as well as some implication of these technologies for vocational and industrial teacher education. (18 pp.)

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